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BALLOONING MISHAPS.

On the 20th of August last a balloon ascent was made from the Artillery grounds at Berchem, Belgium, by two Belgian officers, Captain Mahanden and Sub-Lieutenant Croy, and a civilian, M. Coulet. The balloon first ascended with a breeze blowing from the southeast, but when it reached a certain height encountered a contrary current, and, passing over Antwerp, drifted seaward. The Scheldt was crossed twice, and the aeronauts thought that they were traveling west, when in reality they were drifting to the North Sea. At 2 A. M. the lights of fishing boats were perceived, and the fishermen shouted that they were drifting to sea. Ballast was thrown out, but at dawn (3 A. M.) the balloon descended once more, and the car touched the water. A big fishing boat was hailed, but failed to take notice, so all the remaining ballast was thrown out, and the balloon ascended again for a short time; but, catching sight of a steamer, M. Coulet descended, having made a species of anchor for the balloon, consisting of a sailcloth tied to the end of a rope. The vessel proved to be the British steamer Warrior, and a boat was dispatched to the rescue of the exhausted aeronauts, Lieutenant Croy, the only one of the three who could swim, having taken off his uniform and thrown it into the sea. All three aeronauts jumped out of the car at the same time and were picked up, taken on board, and landed at Dunkirk on the 23d. After the accident, the balloon, relieved of its occupants' weight, again ascended, and was last seen traveling toward the Scotch coast.—Our engravings are from sketches by Mr. F. Bulens, Brussels.

At Ulting, near Maldon, England, on the 27th of August, Mr. Simmons, a veteran aeronaut, was killed while endeavoring to land his balloon. He had made a successful ascent from London in his great balloon Cosmos, with two companions. On nearing the coast, fearful of being carried out to sea, he attempted to come down. The balloon became entangled in some tree tops and suddenly burst with a loud report. The balloonists were precipitated to the ground. Mr. Simmons soon died. One of the passengers had a thigh broken, the other escaped without much injury.

AN ANCIENT GEOGRAPHER.

The name of Johann Schoner, of Carlstadt, is well known to all students of early European cartography. He prepared between 1515 and 1533 four terrestrial globes, three of which are preserved in Frankfort, Nuremberg, and Weimar. The fourth, which was made in 1523, was for three centuries regarded as wholly lost, and the fact that it had once existed was only known or suspected from a description published in a small Latin pamphlet by Schoner, which did not answer either of the known globes.

In 1885 the late Mr. Henry Stevens, the well known bibliographer, found the long lost globe at a bookseller's in Munich, and purchased it for Mr. Kalbfleisch, of New York, who added it to his collection of works on American history and geography.

Its value in the history of geography and cartography is that it was the first attempt to depict the discoveries made during Magellan's first circumnavigation of the world. The record of this voyage was written by one Maximilianus Transylvanus, a natural son of the Cardinal-Archbishop of Salzburg, who was then at the court of Charles V., under the care of Peter Martyr, and from this Schoner sketched the additions to the globe.

Schoner himself, in a letter of dedication, says: "What wonderful adventures and what extraordinary men and animals they (Magellan's expedition) beheld, your Reverence will read at length in the epistle relating to the Molucca Islands addressed by Maximilianus Transylvanus to the Cardinal-Archbishop of Salzburg. Being desirous to make some small addition to this wonderful survey of the earth, so that what appears very extraordinary to the reader may appear more likely when thus illustrated, I have been at the pains to construct this globe."

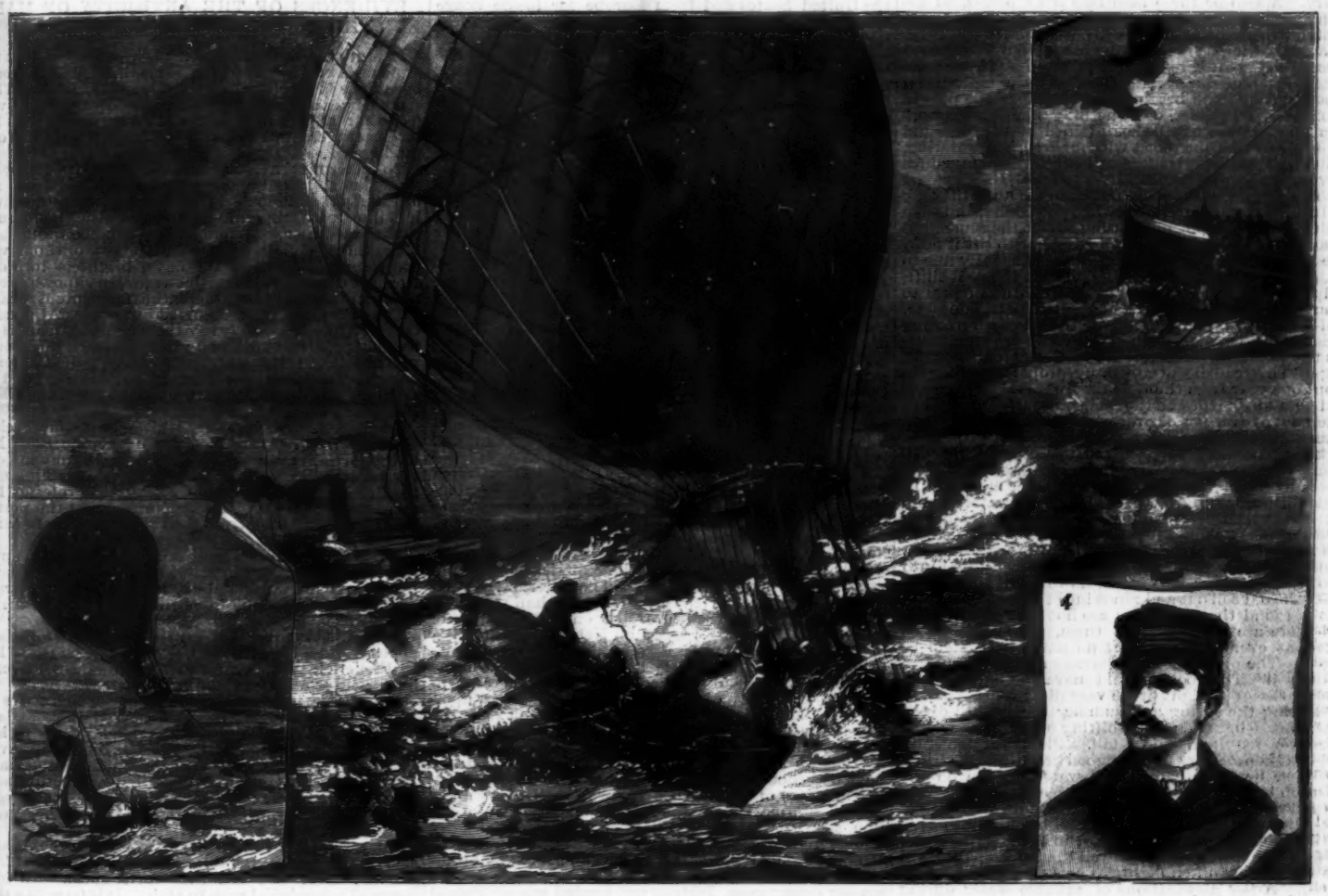
In this and other letters extant of Schoner he dates from a place called Timeripa, which has long baffled all geographers, but Mr. Coote, of the map department of the British Museum, has demonstrated that the mysterious name is only a translation of the German name of the parish of which Schoner was pastor.

At the time of his death Mr. Stevens was engaged in the compilation of a work relating to Schoner, and especially to the long lost globe, which his son, with the aid of Mr. Coote, has succeeded in completing and publishing. The book contains a long introduction by Mr. Coote, showing the value of the globe of 1523, especially in the history of the discovery of the coasts of America, and covering the history of cartography in the 16th century, with a description of the principal maps and globes published during that period.

This is followed by facsimiles and translations of the dedicatory letter of Schoner, and the record of Magellan's voyage by Maximilianus, and by a bibliography of all the cartographer's works.

In a case attached to the book are six beautiful facsimile reproductions, four of globes of a date earlier than 1523, viz., the Hunt-Lenox globe about 1506-7, the Boulonger globe about 1514-17, Schoner's first and second globes, 1515 and 1520; the fifth of the long lost globe of 1523, and the sixth of the famous Cantino map of 1502.

The volume, therefore, besides describing a valuable example of early cartography which had been lost to the world for three centuries and more, forms an important contribution to the history of the maps and globes produced in Europe at a time when the longing for travel and exploration was beginning to seize on European nations.



1 The balloon with an anchor trailing in the sea. 2. The rescue. 3. The balloon disappearing into the clouds. 4. M. Coulet, the aeronaut.

RESCUE OF BELGIAN MILITARY AERONAUTS IN THE NORTH SEA BY THE BRITISH STEAMSHIP WARRIOR.

Linseed gum has been suggested as a substitute for gum arabic. The seeds are first boiled with water for an hour, the resulting thick mass filtered, and then treated with twice its volume of 90 per cent. of spirits of wine. A flocculent white precipitate separates, from which the dilute spirit can be readily decanted. A yield of 10 per cent. of dried "gummi lini" on the weight of the seeds taken is obtained. The gum forms a clear, gray brown, fragile mass, which dissolves in water without taste or smell, similarly to gum arabic. Two grammes are sufficient to form an emulsion with 30 grammes of oil, which resembles the emulsion formed with gum arabic, both in taste and in appearance.

THE CULTIVATION OF PALMS.

AT the recent florists' convention, Mr. C. D. Ball, of Holmesburg, Pa., read a paper on "Ferns, Palms, and Decorative Plants," from which we take the following:

"Nearly all palms are propagated from imported seeds, which, if obtained fresh, are not difficult to germinate. Orders should be placed early enough to insure getting new crops as soon as possible after being gathered. Some varieties soon lose their vitality, and the sooner they are planted after being received, the more likelihood there will be of good results. In sowing I use five or six inch pots, filling them about one-third full of broken pot or charcoal for drainage. The soil used should be a mixture of about equal parts finely sifted peat and loam, to which a little sand is added. The seeds can be planted thickly, almost touching each other. They should be covered with from half an inch to an inch deep, according to the kind and size of seeds, and the surface pressed firm and smooth. Then plunge the pots to the rim in cocoa fiber in a warm house, where a fair bottom heat can be maintained. The soil should be kept always moist, but not wet, or the seeds are likely to decay before they germinate. By plunging the pots in the manner recommended, it can be kept in this condition without frequent watering.

"The time required to germinate varies under different conditions and with different varieties. Some kinds, such as *Areca lutescens*, *Latania Borbonica*, *Cocos Weddeliana*, etc., usually take from one to two months before the growth shows above the surface. The young plants should not be potted off too soon; it is better to leave them until they are thoroughly rooted and the tops are well up. *Areca lutescens*, Kentias, and some others of this type should be left until the second leaf appears. When ready they should be potted off into as small sized pots as will contain the roots without injury. A two or three inch rose pot I prefer, on account of the long, stiff roots made. The soil should be about the same as that used for the seeds.

"After potting they should be placed in a close, warm house. Yet great care must be taken in watering; the roots and foliage are tender, and easily damped off if kept too wet. The best plan is to plunge the pots in cocoa fiber, fine ashes, or something similar. A more even temperature can be maintained at the roots and the soil can be kept moist without frequent watering. A little bottom heat is of great help to the plants until they have become established.

"The second shift should not be made until they are well rooted through and somewhat pot-bound, and then to the next sized pot only, using about the same kind of soil as before, although it is best not to sift it now. The larger pieces can be chopped up sufficiently fine to use, as palms like open, fibrous soil. At the next shift, and from that time on, I lessen the quantity of peat to about one-third part and add a small portion of fine, well-rotted cow manure for all the stronger rooting varieties. With most of the more rapid growing varieties the plant will now have reached the four-inch pot stage. This can be attained by proper handling in about one year from the time they were taken from the seed pots. From now on the same precautions should be taken not to over-pot or over-water at the roots. Good drainage in the pots is always essential, as the soil must be kept pure and well drained. While growing, all palms require frequent syringing over the foliage, especially during the spring and summer months. In winter little or no growth is made, and water should not be applied so liberally. About the middle of February they should be thoroughly overhauled, as this is the time they will want to move forward again. Those requiring more pot room should be shifted into a pot a size larger; very often, however, it is better to shake the old soil out and repot into the same sized pot if it is found that the roots are not perfectly healthy and there are not plenty of them. Care should be taken at every potting that no part of the stem be buried. The plant base must merely rest on the surface of the soil. The roots should never be cut, as with some varieties it might prove very disastrous.

"During the spring and summer the growth of the year should be made, and shifting on should be done, whenever required, before fall. Plenty of moisture and heat is necessary to get a good growth, and syringing, once or twice a day, and water thrown on the paths on hot, sunny days is advisable. Sufficient ventilation should not be overlooked, as pure air is essential. Even during the summer it is often well to keep the fires going slowly, to maintain an even temperature. The houses should be kept well shaded, as palms will not stand the full sunlight. The foliage is easily affected. A few applications of manure water during the summer will be very beneficial with most varieties.

"If wanted for fall sales, they should be hardened off before that time by gradually lowering the temperature and admitting air more freely; it would not do to send them out in a soft condition."

[GARDEN AND FOREST.]

THE FORESTS OF THE UNITED STATES.

IF the lumbermen of the United States will take the ninth volume of the tenth census reports and read the estimates and statistics on the standing timber of the United States and compare with them the amount of timber cut and sold in the past eight years, in connection with careful estimates being now made over the same ground in the timber States of Michigan, Wisconsin, Minnesota, California, Oregon, Pennsylvania, and Maine, they will be convinced that time has proved our estimates to have been approximately correct. The careful examination of that census work, especially the object lessons presented by the maps of forest areas, will give, too, some knowledge on timber matters. In Wisconsin, for example, the estimate in 1880 of standing pine was some forty-one billion feet board measure, of which fifteen billion was in the Chippewa Valley. The eight years' cutting and the present amount of standing timber, estimated now at less than ten billion feet, show the 1880 estimate a fair one. Again, the redwood of California was estimated in the census report at twenty-five billion; there has been an annual cutting of some three hundred and twenty-five million since; the present estimate being about twenty billion feet, and including much that is not very available. It is claimed that Michigan has less than thirty billion left, and the amount in Minnesota is probably about eight or ten billion feet. Since 1880, the available timber in the Southern timber States, from the Carolinas around to and including Texas, the country of the long-leaved pine, has been more thoroughly explored and estimated, and the available timber has been purchased largely, mostly by Northern lumbermen, who know the value of timber, and who, having sawed up or sold out their own, have bought this cheap pine and cypress as an investment, paying about twenty and twenty-five cents per thousand. These estimates and more careful reports of expert woodsmen do not add to the census figures. I think, on the whole, the last report is generally the smaller. On the Pacific Coast great changes have taken place in this respect. In California, up to 1880, little, if anything, was known of the amount or value of the redwood of the coast or of the sugar pine of the Sierras. Now the former is all in hands of second and third parties, mostly owned by practical lumbermen, who will hold and manufacture it.

The sugar pine we may call a "reserve," as it can only be reached by long flumes. In Oregon there is not much change. In Washington Territory, especially about Puget Sound, there has been a decided advance in values, new mills have been built, large companies have been organized, who are purchasing timber from the railroads and from government, and are preparing for extensive manufactures of the fir and cedar. To say that there is of the firs, cedars, and other merchantable timbers in Washington Territory, Oregon, and in the Pend d'Oreille region of Idaho, five hundred billion feet, would, I think, judging from an extensive examination made in 1882 and 1883, and from reliable sources, be low enough; that it will much exceed this estimate when cut, unless fires destroy it, is my belief. In the Middle States of West Virginia, Kentucky, Tennessee, and in parts of Ohio, extensive bodies of the hardwoods remain not much encroached upon. Still the steadily advancing prices, the greater demand all over the United States and from Europe for inside house finish, agricultural implements, etc., show that these woods are getting more scarce and valuable.

North of us, in Canada, lumber does not seem to cut the figure it once did. The inexhaustible forests of the distant regions have shrunk considerably under the more critical examination of timber buyers and their explorers. The Spanish River country, the north shore of Lake Superior, the vast "limits" of the Lake of the Woods and the Rainy Lake River country, do not materialize in timber as represented by the Canada company who sold the foreigners the "limits." Winnipeg and the country westward is largely supplied now from the rivers in Minnesota that empty into Rainy Lake and the Lake of the Woods. The lumber is manufactured on the Canada Pacific Railroad, and sent over the road to Winnipeg and beyond. These are facts. I have no timber to sell, no reason to understate amounts, but I simply wish to make a fair statement based upon long study of the present condition of our forests which contain timber of commercial value.

Having referred in a former letter to the European supply, I will add that the countries of Australia, China, Japan and Mexico already draw from us largely for lumber, their native supplies being mainly in almost inaccessible mountain regions. Mexico has considerable timber, but it is inaccessible at present, and it must probably remain so for a long time.

So we may congratulate ourselves here in the United States that we still have in our forests a wonderful inheritance, of a value that, if estimated, would run into the thousands of millions of dollars, and all this not covered up in the ground, but in plain sight and upon its surface.

Now, being forewarned by the experience of the old world, let us learn something. The Interior Department at Washington tells us, after more than ten years' trial of the timber culture act on the prairies of Minnesota, Dakota, Kansas, and Nebraska, that it is a miserable failure, though it agreed to convey for nothing one hundred and sixty acres of the best soil in the world to every man who could or would succeed in making ten acres of trees of any kind grow upon the land, after eight years' trial. They don't raise the trees. In after years it may be done, but so far the act is a failure, and should be repealed.

What we should learn is to preserve the forests we have by proper legislation, by educating and appointing foresters of intelligence to care for them, by publishing information on the subject—practical information, such as farmers and timber owners can readily understand and apply. American youths should be taught at school and at home that no fires must be allowed to run and that cattle must not run at large among young trees. District and graded schools should be supplied with collections of woods, and pupils should be encouraged to study them.

We appropriated millions upon millions of dollars' worth of land in 1862 for agricultural colleges. One million acres of this was taken in Wisconsin alone, and mostly for the benefit of other States. The Cornell University of New York took five hundred thousand acres of this pine timber. Much of this land is to day worth $50 or more an acre for its timber. The same is true of Michigan and Minnesota. Henceforth the government should in justice to these three States give to them outright the proceeds of future sales for the establishment of schools of forestry and to pay trained foresters to care for the forests. The same should be done in the Southern timber States. An explorer in Alabama writes me, "I can buy for you in this State very finely timbered pine lands at government price, $1.25 per acre." Why not advance the price, if the government must have the $1.25 per acre, to $2 50 per acre, and give Alabama the $1.25 taken from the speculator, and let her have a school of forestry? All over our land we are losing millions by ignorance and carelessness on the subject of forest fires. The people do not realize it at all, especially in our Western States and Territories. In Oregon, Washington Territory, Montana, and Idaho, among the firs and yellow pines, the fires are doing the most damage. I have seen millions of acres made bare by fires that were the result of carelessness along the railways in Washington Territory and Idaho. The very fact that a government forester was ranging the forests about Puget Sound, the Columbia and Willamette Rivers would have a good influence in every lumber camp and along every railroad. I have seen one burning started by a gang of railroad workmen in Washington Territory that destroyed over one million dollars' worth of timber. This fire never would have occurred if such carelessness had been made criminal by law, and if an officer of the government had been within reach to enforce it. There is no question but that if $250,000 a year were even properly spent in care of forests and forest education, it would add millions to future forest values.

H. C. PUTNAM.

Eau Claire, Wisconsin.

FRUIT GROWING IN JAMAICA.

FRUIT growing, of almost every kind, with a good market in the United States of America, may be recommended to settlers in Jamaica as a promising enterprise, and the following notes on that subject give correct information:

The export of bananas from Jamaica to America has of late years become important. The Atlas Steamship Company, trading between Jamaica and New York, carries at least 50,000 bunches of bananas every month, besides other steamers trading with Kingston. The Atlas steamers call for this favorite fruit at Kingston, Port Morant, Morant Bay, and Annatto Bay. The other companies' vessels carry from 8,000 to 10,000 bunches per month. Besides this large quantity of bananas, there are from 10,000 to 15,000 barrels of oranges exported from the island to New York, Baltimore, Boston, Philadelphia, and other ports.

The banana tree bears but one bunch in its life, and when this is cut the tree dies, leaving, however, numerous suckers, which soon come up, and thus replace the old tree. The growth is very fast, it is going on all the year round. Some bunches weigh as much as 150 lb., the average being from 80 lb. to 90 lb. The average number of bananas on each bunch is about 200.—*Illustrated London News.*

EVIDENCES OF THE ANTIQUITY OF MAN IN EASTERN NORTH AMERICA.*

IN studying the history of man, we have to adopt the same methods and draw the same inferences as have been done in tracing the evolution of animals. This, strangely enough, seems repugnant to very many, who feel that any relationship, however remote, with less intelligent creatures is a reflection upon their own intelligence.

To determine at what precise point in geological time man appeared upon the earth is, it seems to me, obviously impracticable, from the fact that the dividing line separating humanity from the non-human cannot be drawn. It were as easy to name the moment when the gloaming merges into night, or shout with confidence "Now!" as the dawn brightens into day. Nor is it demonstrable, with our present knowledge, to point to that country where the momentous change first took place, if it occurred but once. At present, however, we can safely say that miocene man is extremely problematical, and pliocene man a question as yet unsettled; the auriferous gravels of California being pronounced late tertiary by Whitney, and by Le Conte as representing "the beginning of the glacial epoch."

At all events, we have neolithic man as far back as the glacial epoch, and possibly in the pliocene. Man in the tertiaries, therefore, championed by my honored predecessor, Professor Morse, becomes something more tangible than a hypothetical creature. Professor Putnam has arrived at the conclusion that the western coast of our continent was inhabited by man in earlier geological times than the eastern half.

Mr. Warren Upham has examined the drift formation of Little Falls, Minn., where Miss Babbitt found those extremely rude but unquestionably worked quartzes, and describes it as the flood plain of a river of the glacial epoch.

In 1883, as the result of exhaustive studies of glacial deposits, from New Jersey westward, across Ohio, Rev. G. Frederick Wright predicted that traces of paleolithic man would be found in the latter State.

Paleolithic implements, concerning which there can be no doubt, have not been discovered in abundance as yet, but Professor Wright's belief proves to have been well founded. Dr. C. L. Metz, of Madisonville, O., has discovered two specimens which set the matter at rest. Both were found at significant depths, one of them nearly thirty feet below the surface. The region where found is one characterized by immense gravel deposits of glacial age and origin.

They show that in Ohio, as well as on the Atlantic coast, man was an inhabitant before the close of the glacial period. We can henceforth speak with confidence of interglacial man in Ohio. It is facts like these which give archæological significance to the present fruitful inquiries concerning the date of the glacial epoch in North America.

Mr. Hilborne T. Cresson has discovered two chipped implements of argillite which he found *in situ*, at a depth of several feet from the surface, in railroad cuttings through the old terrace of the Delaware River near Claymont, Del. The geological position of these specimens will excite discussion, but their great age will not be questioned. Of particular interest, in relation to discoveries in the gravels at Trenton and Ohio, is the discovery of a large flint implement found by Mr. Cresson in the glacial gravel in Jackson County, Ind.

From evidence so far obtained, it seems that on either seaboard paleolithic man lived in great numbers and that as a coast dweller he pre-eminently flourished. In the valley of the Delaware River paleolithic man has left such abundant traces of his former presence, in the form of rudely fashioned stone implements, that for long they were considered as the hasty or unfinished work of the later Indians.

As the first to point out what is now maintained by competent archæologists to be their real significance, I may be pardoned for devoting the conclusion of my address to a consideration of that region—the Delaware valley—so far as its physical character and the traces of prehistoric man found there have a bearing on the question of the antiquity of man in America.

The question may now be asked, What is a paleolithic implement? It is not very readily defined, as there

* Abstract of an address before the Section of Anthropology of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15-22, 1888, by Charles C. Abbett, vice-president of the section.—From *Science*.

is considerable variation in the shape; but as I understand the significance of the term, it is properly applied to coarsely chipped masses of flinty rock, upon which a distinctly designed cutting edge is formed, to which is often added an acute point. Furthermore, they show unmistakable evidence of antiquity by the weathering of their surfaces; and they are found as a rule, but not necessarily always, in deposits of glacial or river drift with which they agree in age.

How far do these Trentonian implements meet with these requirements?

My own impression of their true character was not suddenly reached. The evidence of other kind, of the antiquity of the Indian, led me to consider them as rude objects made for some trivial purpose and discarded. Later, I became convinced that they were older than ordinary surface-found relics, and assumed that the Indian of history commenced his career in this valley while in the paleolithic stage of culture.

Thus, while pursuing my collecting of Indian relics, it was gradually forced upon my mind that these rude implements were more intimately associated with the gravel than with the surface of the ground and the relics of the Indians found upon it.

Acting upon this, I continued for two years to examine most carefully both the surface of our fields and every exposure of the underlying gravels; and in June, 1876, after having found several chipped implements *in situ*, expressed the opinion that the Delaware River, "now occupying a comparatively small and shallow channel, once flowed at an elevation of nearly fifty feet above its present level; and it was when such a mighty stream as this, that man first gazed upon its waters, and lost those rude weapons in its swift current that now, in the beds of gravel which its floods have deposited, are alike the puzzle and delight of the archæologist. Had these first-comers, like the troglodytes of France, convenient caves to shelter them, doubtless we should have their better wrought implements of bone to tell more surely the story of their ancient sojourn here; but, wanting them, their history is not altogether lost, and in the rude weapons now deeply embedded in the river's banks we learn at least the fact of the presence, in the distant past, of an earlier people than the Indian."

Thus it will be seen that I have been fairly cautious in my statements, and slow in reaching any conclusions with reference to these implements which separated them from ordinary Indian relics.

But admitting that a given class of stone implements is characteristic of a given deposit of gravel (and I think we must admit this now), what is the geological history of this deposit? Is it too recent to be of special import, or too ancient to be of archæological significance? Both views have been held, and neither proves tenable. That the former view should have found supporters is indeed strange. Certainly there is now no movement of the gravel by the river, whatever its condition or freshet stage; and certainly, if these rude forms were of identical origin with common Indian relics, then rude and elaborate alike—jasper, quartz, porphyry, and slate together; axes, spears, pottery, and ornaments, all of which are found upon the surface—should have gradually become commingled with the gravel, even to great depths. Any disturbance that would bury one would inhume alike the various forms of neolithic implements. Such, however, is not the case.

How old, and not how recent, are the Delaware valley or, as they are now known, Trenton gravels? This it is all important should be definitely determined. A clear light has been thrown upon these questions by G. F. Wright, who shows that these gravels are the last important result of the glacial epoch, the direct result of the melting of the glaciers, as they retired northward; and that, while this was in progress, the rude implements of paleolithic man were lost and embedded in them.

Admitting this, how long ago did it take place?

If we accept the most moderate estimate of the length of postglacial time, some six thousand years, we have of interglacial time (*i. e.*, between the first and second epochs) from eighteen thousand to sixty thousand years; and to this, as I understand the matter, must be added the long stretch of time during which the second epoch of cold continued. Assuming, therefore, that geologists have made no mistake, archæology has time enough and to spare. At no time was the continent uninhabitable, however thick and wide-reaching the ice, or deeply submerged the lower-lying areas. Still there was land enough for mammalian life in all its glory, and it flourished at the very foot of the advancing ice sheet, and re-entered every tract as the glaciers withdrew. Then we had the mastodon and mammoth, reindeer and bison, musk ox and moose, and man familiar with them all.

Having made clear, I trust, what is meant by paleolithic man, and shown also that he *was* a fact and *is* not a fancy, the question naturally arises, What was his fate? Did he, like the mastodon, become extinct, or has he descendants still living on this continent? If the paleolithic implements were strictly confined to the gravel deposits, like fossils in the underlying marl beds, then, as it seems to me, we would be unable to refer paleolithic man to any branch of the human race now alive; but, as a matter of fact, there is no such break—no evidence of an hiatus of greater or less duration between paleolithic man and the Indian. The former continued to dwell here until the last pebble of the great gravel deposit had been laid down, and possibly into the soil-making period, but not now, as paleolithic man.

The significant advance to the manufacture of more specialized implements took place; the rude argillite paleolith, the same in form the world over, giving way to spears and other definite forms. The form of the product altered, but the same material, argillite, continued in use. There was no pottery, no polished stone, little if any attempt at ornamentation; still, when we compare these later objects of argillite with the earlier and original patterns, we see what a tremendous forward stride had been made.

Next we have to consider the important fact that the flint implements known as Indian relics belong to the superficial black soil, while at the base of this deposit of soil the argillite implements occur in greatest abundance.

This briefly covers the range of evidence, first, that paleolithic man did not become extinct; second, that his descendants attained to an advanced degree of culture in the land of their forefathers. What, then, was this people's subsequent career? Were it not for the three skulls found in the Trenton gravels, we could still maintain that we have their descendants in the Eskimo, and that they were finally driven north, after contact with the Indians, who, as is conceded by all students, migrated hither at, archæologically considered, a not exceedingly remote period. The Indian traditions assert that they found the region occupied; and for once, at least, we have evidence which confirms tradition.

However others may be impressed by what I have now presented, for myself, as I wander along the pleasant shores of the Delaware River, seeing it but a meager stream between high banks in midsummer, or in winter swollen and choked with ice until these are almost hidden, I recall what time this same stream was the mighty channel of glacial floods, pouring seaward from the mountains beyond, and picture the primitive hunter of that ancient time, armed with but a sharpened stone, in quest of unwary game. And later, when the floods had abated and the waters filled but the channel of to-day, I recall that more skillful folk who with spear and knife captured whatsoever creature their needs demanded—the earlier and later chippers of argillite.

These pass; and the Indian, with his jasper, quartz, copper, and polished stone, looms up as the others fade away. His history, reaching forward almost to the present, I leave in the hands of others to record.

HISTORY OF THE DWELLING.

IN spite of certain new pessimists, work on the universal exhibition is being actively pursued, and will soon force public attention to forsake politics to some extent. While the Eiffel tower is reaching completion and the domes and porticoes of the various pavilions are exhibiting their framework in space, the artists and architects are thinking of working up certain parts which, by their purely artistic character, have no other object than to give rest to, and instruct, and at the same time charm, such visitors as are fatigued by their ramble through the buildings of the Champs de Mars. It is in this spirit, at least, that Mr. Charles Garnier has conceived the structures that we illustrate herewith from his drawings. It has been Mr. Garnier's idea to give the history of the human dwelling—in action. That corner of the Champs de Mars at the Exposition of 1878 called the Avenue of Nations, which, with its double row of houses of every style, resembled a cosmopolitan city, will not have been forgotten. To show us the modern architecture of various countries was an excellent idea. Some persons, while approving of it, said that the lesson would have been completer if to that image of contemporary art had been added that of past art. Since that epoch, Mr. Garnier has conceived the project of his history of the human dwelling. The elements of this he submitted to Mr. Alphand, who made himself its defender before the financial committee, which put at the architect's disposal $100,000. Next year, then, we shall be able to make an excursion to the abodes of our ancestors (on the D'Orsay quay, between Suffren and Bourdonnaye Avenues), in the forty-nine types of dwellings that we represent.

Mr. Garnier has divided his history of dwellings into two periods—prehistoric and historic.

The prehistoric period comprises four types of dwellings, viz., open air (shelter under rocks); grottoes (troglodytes); on water (lacustrine cities); on the ground (huts and menhirs).

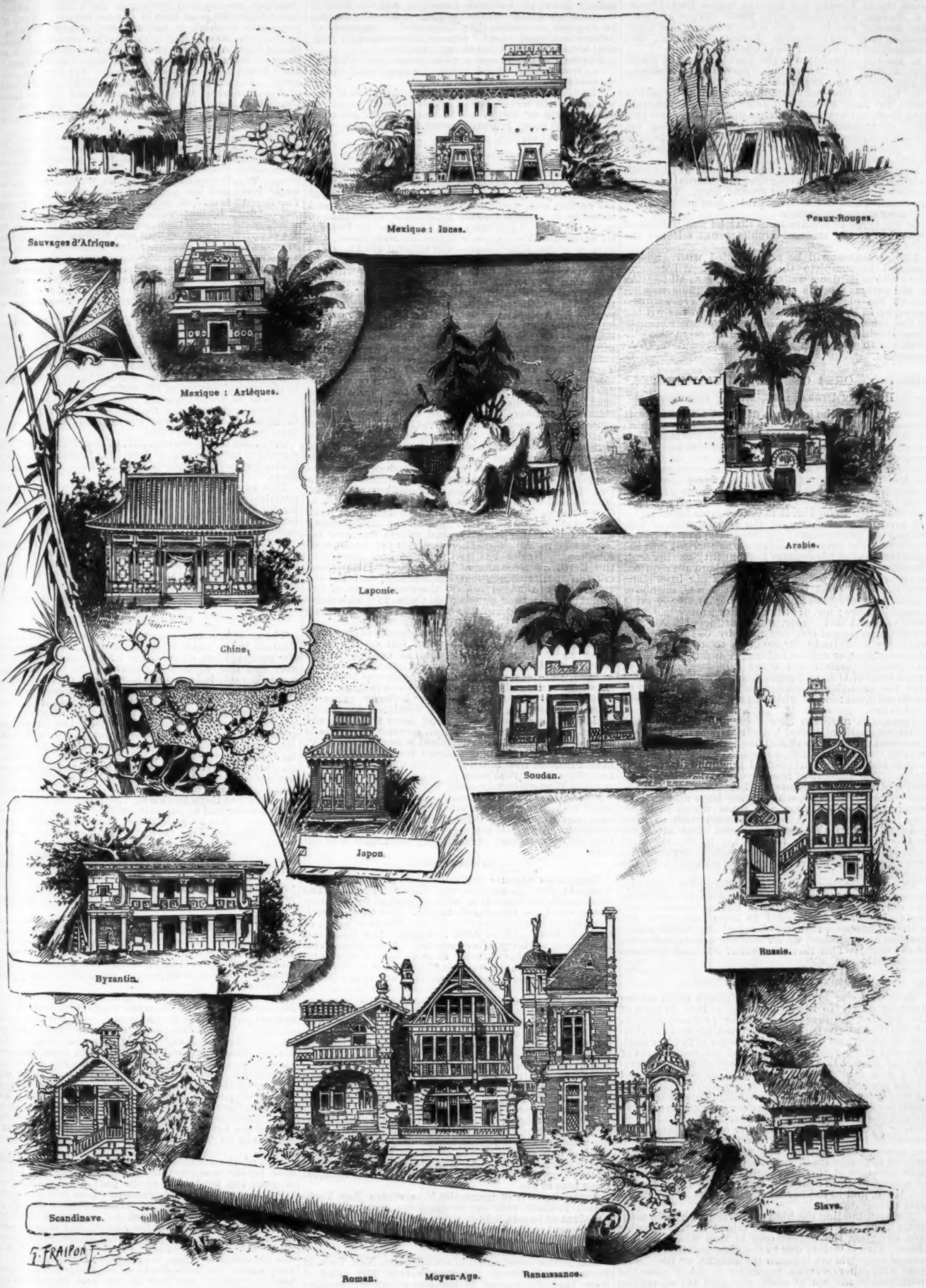
In the historic period, there are five subdivisions:

1. Primitive civilization. Types of dwellings among the Egyptians, the Assyrians, Phœnicians, Hebrews, Palasgians, and Etruscans, before Jesus Christ.

2. Civilization due to the invasion of the Aryans.

COLLECTING AND COUNTING BUNCHES OF BANANAS IN JAMAICA.—[FOR DESCRIPTION SEE OPPOSITE PAGE.]

THE HISTORY OF HABITATIONS. ILLUSTRATED AT THE FRENCH EXPOSITION OF 1889, BY CHARLES GARNIER.



THE HISTORY OF HABITATIONS. ILLUSTRATED AT THE FRENCH EXPOSITION OF 1889, BY CHARLES GARNIER.

Types of dwellings among the Hindoos, Persians, Germans, Gauls, Greeks, and Romans, before Jesus Christ.

3. Roman civilization in the West. Types of dwellings among the Huns and Scandinavians, and specimens of the Gallo-Roman, Roman, Mediæval, and Renaissance types, after Jesus Christ.

4. Roman civilization in the East. Types of dwellings among the Byzantines, Slavonians, Russians, Arabs. Turks, and Soudanians, after Christ.

5. Civilizations contemporaneous with primitive ones; but such as did not enter into communication with them or have any influence upon the general progress of humanity. Types of dwellings among the Chinese, Japanese, Eskimos, Laplanders, the peoples of Equatorial and Southern Africa, the Redskins, the Aztecs and Incas.

This resurrection of the ancient world will be both external and internal, saving that the internal arrangements will comprise only the ground floor. The modest amount allowed to Mr. Garnier does not permit of a display of useless luxury.

Of the types of architectures that he was desirous of reproducing, the eminent architect has selected the most ancient.

The structures will be accompanied with annexes designed to complete their character. All around, there will be gardens, wells, fountains, etc., all relating to the various epochs studied. Inscriptions making known the place of derivation of the types will be drawn up in French, and also according to the writing of the time. Mr. Garnier likewise intends to people these dwellings with persons wearing costumes conformable to the types and epochs represented.—*L'Illustration.*

THE IRON ORES OF THE UNITED STATES.*

By John Birkinbine, Mining Engineer.

In considering the iron ores of the United States, it is essential that we first note the sources from which come the supply of mineral consumed in the manufacture of 5,683,329 gross tons of pig iron in 1886 and 6,417,148 gross tons† of pig iron in 1887, as well as the ore used for fettling in rolling mills, the amount required for the production of blooms by direct processes, bloomaries, and other purposes. Probably 11,500,000 gross tons of iron ore were used in this country in 1886, and the estimate for 1887 is 13,000,000 gross tons.

A careful investigation of the consumption of iron ore and the production of pig iron in the United States shows that the average yield of ore as charged into the blast furnaces of the country is about fifty-one per cent. Therefore a little less than two tons of ore are required on the average to produce one ton of pig iron. The output of 577 blast furnaces in 1886 was, as above stated, 5,683,329 gross tons, requiring 11,300,000 gross tons of iron ore; but of this quantity probably 300,000 gross tons was mill cinder, which deducted leaves 11,000,000 gross tons of iron ore used by our furnaces, to which we should add 500,000 gross tons consumed in bloomary fires, or used as fettling, or as flux in smelting the precious metals and other purposes, making a grand total of 11,500,000 gross tons. Similar estimates give the probable consumption of iron ore in 1887 as 13,000,000 gross tons, of which nearly ten per cent. was foreign ore.

There is in northern New York and in some of the Southern States a limited industry where iron ores are converted into "loupes" and hammered into blooms in open "bloomary" fires, sometimes called "Catalan" forges, after the ancient method pursued in Catalonia, Spain. The amount of iron produced in this way in 1887 was but 15,088 net tons or 13,471 gross tons. Various "direct" processes, which have been and are still being experimented upon, and upon which so much time and money have been expended with so little practical result, also used some ore. Our attention will be devoted entirely to smelting in the 583 blast furnaces of the country, the great bulk of our domestic iron ores, as well as the foreign ores brought into the United States.

There are to-day in the United States 676 blast furnaces, but ninety-three of these have been dropped from the official record by reason of having outlived their usefulness, or having failed to keep pace with the march of improvement, which raised our blast furnace practice to a standard which commands the admiration of the world. This leaves a total of 583 blast furnaces on the active list.

COMPOSITION OF IRON ORES.

Enthusiasts or novices still occasionally claim an ore yielding eighty to ninety per cent. of iron, in spite of the fact that the magnetic oxide or proto-sesquioxide of iron (Fe_3O_4), the base of our magnetites, and the richest ore which can be obtained, consists of 72·4 per cent. iron and 27·6 per cent. oxygen; and the sesquioxide of iron or ferric oxide (Fe_2O_3), the base of all our hematites, is a combination of seventy per cent. iron and thirty per cent. of oxygen. There is also the protoxide of iron or ferrous oxide (FeO), containing nearly seventy-eight per cent. of iron, but this does not exist in our ores except in combination, as in the carbonate of iron (FeO CO_2 or $FeCO_3$). However, all the ores are mixed with earthy or rock gangue and carry sulphur, phosphorus, manganese, titanium, and more or less water, and seldom approximate theoretical purity; the most notable instances of this approach being in large crystals of magnetite from near Port Henry, N. Y., and Republic, Mich., and in the harder specular ores of Michigan and Minnesota.

Notwithstanding the high proportion of iron in magnetic oxide, the red hematites mined in this country are, as a class, the richest ores in iron which we produce. This is largely due to the dissemination of crystals of magnetic ore through the gangue, or their mixture with other crystals, requiring in many cases the reduction of the ore to small size, and the separation by gravitation or by magnetism of the particles.

The red hematites differ only from the brown hematites in the former carrying less water than the latter; and the subdivision of the brown hematites into "turgite," "goethite," "limonite," and "bog ore," etc., is mainly due to the water they contain, and the more or less intimate mixture of the peroxide and earthy matter. Of the red hematites, the "specular," "micaceous," "dye stone," and "fossil" ores are determined by physical structure or association with gangue.

The carbonate iron ores are also classed as "siderite," "clay iron stone," "black band," "kidney ore," etc., in various localities.

The carbonates are based on the combination of carbonic acid and ferrous oxide, above referred to, and if existing pure as $FeCO_3$ would contain 48·27 per cent. of iron, but these generally occur in connection with carbonaceous matter.

DISTRIBUTION OF IRON ORES.

An enumeration of the localities from which American iron ores are obtained, and a discussion of the peculiarities of occurrence, formation, or composition of the various ores, would require a course of lectures, and therefore in a single evening no attempt, other than to cover the ground generally, will be made. In twenty-six States and Territories iron ores are now mined, and in most of the others deposits of mineral are known to exist in workable quantity.

In every State east of the Mississippi River, with the exception of Florida and Mississippi, iron ores have been or are now mined, and in Mississippi I lately inspected a weathered carbonate covering considerable territory. A deposit of bog ore in Florida is now being investigated, and plans for a blast furnace to utilize it drawn. Of the other States, we immediately recognize Minnesota and Missouri as containing a wealth of excellent ores. Iowa and Arkansas, Louisiana and Texas, have known deposits as yet undeveloped, although in the last named State some of the ores in the northeast section have been smelted. A sample of excellent brown hematite, probably a weathered carbonate, from near Council Bluffs, and a limonite from central Iowa, were lately received. Of the Western States, Colorado, Utah, California, Oregon, and Washington Territory have produced ores, and deposits of mineral are reported in other Territories. In fact, it would be unwise to assert that iron ore does not exist in workable deposits in any one of the political subdivisions of the United States, and our neighbors of Canada, Mexico, and Cuba can boast of remarkable supplies of this mineral. Some of the Canadian iron ores have been exploited by American capital, the output being shipped into this country, and efforts are now being made to develop other deposits for home consumption. Mexico has its unrivaled iron mountain, the Cerro de Mercado, at Durango, and numerous minor deposits throughout the republic, and the development of the iron ore on the south shore of the island of Cuba, near Santiago de Cuba, in which some of our large steel companies are interested, is now well known.

In locating in a general way the deposits of iron ores, no attempt will be made to point out on the map* those which have been reported as existing in the western portion of the continent, for but few have been worked, and information as to the numerous favorable showings is not sufficiently definite to be reliable. We may, however, note that an iron industry exists at Port Townsend, in Washington Territory, for which some ore is obtained locally, and some from Texada Island, British Columbia, and an English syndicate is now constructing a large steel plant at Seattle, Wash. T. At Oswego, Ore., and at Clipper Gap, Cal., there are blast furnaces, now inactive, but for which local brown hematites form the bases of supply. The most important Western development is at South Pueblo, Col., where various Colorado ores are smelted. Iron on a small scale has also been made in Utah, and considerable iron ore is used throughout the West in silver smelting. A general summary of the present exploited iron ore deposits east of the Rocky Mountains is as follows:

MAGNETITES.

Magnetites abound in Canada and occur in Maine, Vermont, New Hampshire, and Rhode Island, but the most northerly deposits at present worked in quantity are in the Lake Champlain region. The Chateaugay, Port Henry, and Crown Point mines, the most noted of these, lie from 1,200 to 2,000 feet above the lake, and from seven to thirty miles westward. Some magnetites have, however, been found close to Lake Champlain, and others are on the western slope of the Adirondack mountain range. A few of these ores are of the Bessemer grade, but it is believed that more can be made so by crushing the ore and separating the apatite (phosphate of lime) from the iron crystals. Concentration and separation is now carried on to a large extent, and the use of fine ore in the blast furnace is causing no serious trouble. Considerable magnetic ore sand is found along the coasts of California and Long Island Sound, some of which has been separated by magnetic machines, and it has been claimed that the subaqueous deposit from whence these sands emanate affects ships' compasses; in fact, Mr. Edison attributed the loss of the Oregon to such magnetic disturbances.

The Lake Champlain district produces about 500,000 tons per annum, and up to date is credited with having yielded 13,500,000 gross tons of ore, which has been smelted in blast furnaces or reduced by the direct process in bloomary fires. An area of one-half square mile west of Port Henry has, it is claimed, produced 3,500,000 gross tons of ore.

Some deposits of magnetite in northern New York, which indicate rich ore in quantity, carry so much titanium as to seriously interfere with their smelting in the present state of our knowledge of ore concentration and blast furnace practice, but this, like other drawbacks, will be overcome.

Magnetites occur again in southeastern New York, in Putnam and Orange Counties, within fifty miles of New York City, those of the former county, such as the Tilly Foster and Croton Mines, being prominent, owing to peculiarities of formation and composition. Some are apparently large lenses or chimneys of ore with faults, making mining expensive. The annual output of these mines approximates 45,000 tons.

Tracing the magnetites from southern to New York into northern New Jersey, we find numerous mines in that State producing in the aggregate over 500,000 gross tons per annum, and having in their history added about 16,000,000 gross tons to our ore supply. Many of these ores are high in sulphur and require roasting. In northern New Jersey "franklinite" occurs. This is an ore containing zinc, manganese, and iron, which is smelted in small furnaces to produce "spiegeleisen" after it has been roasted, to remove the zinc, as zinc oxide. Occasionally very large crystals (with faces of five inches) of franklinite are found. The Lake Champlain region has been worked since 1804, and the New Jersey magnetic mines have been producers for over a century.

Following the ranges of hills into Pennsylvania, the magnetic iron ores occur along the South Mountain, the prominent deposits in this State being at Boyertown, along French Creek, at Cornwall, and at Dillsburg. The Cornwall ore hills are worked above the water level, and are practically on elevated ground. The deposit is unique, consisting of a mass of magnetic ore, confined by trap walls forming three hills, and is mined more cheaply than any ore of similar grade in the country. The Cornwall ore, while sufficiently low in phosphorus for Bessemer steel purposes, carries, on an average, two per cent. of sulphur, which is partially removed by roasting in kilns with waste coal. The Cornwall ore hills have been worked for over 150 years, and the aggregate output to date is 8,673,000 gross tons, of which 687,210 gross tons were mined in 1887.

The general topographical and geological structure continuing through Maryland, Virginia, North Carolina, South Carolina, Georgia, Alabama, and Tennessee, magnetites are found in these States, the largest developments being in North Carolina, notably at the Cranberry mines in the western and a titaniferous deposit in the central portion of the State.

(It was in North Carolina that the first discovery of iron ores in this country was made three centuries ago, in 1585, but the first iron ore shipped from America came from Virginia in 1608.)

Ores exist in the western part of South Carolina, and a century ago smelting of these was introduced in that State, but for thirty years there has been no iron made there.

This general group of ores just mentioned comprises practically all the magnetites exploited east of the Rocky Mountains, except occasional deposits in the north peninsula of Michigan and in Missouri; in these cases the magnetites occur with specular red hematites.

With the exception of Cornwall and one or two other deposits, the magnetites are mined underground, a depth of 300 to 800 feet having been obtained in some of the workings of the Lake Champlain, the New Jersey, and the Pennsylvania mines. But few American magnetites are free from sulphur, phosphorus, copper, or titanium.

RED HEMATITES.

The most important operations in mining red hematites are in the Lake Superior district, but to indicate the geographical distribution of this class of ores we may first trace them from northern New York, where a considerable industry has been maintained in mining specular ores, into central New York, where the fossil ores known as "Clinton fossils" are wrought. These latter occur again in Pennsylvania, near Danville, and extend through the central part of the State, supplying stock to numerous blast furnaces; then through Maryland, Virginia, and West Virginia, into eastern Kentucky and Tennessee, being recognized in the latter State as "dyestone ores," and showing their greatest development in Alabama and Georgia. These ores being the basis of supply for the Birmingham, Ala., furnaces, are there known as "Red Mountain" ore.

A peculiar and apparently isolated deposit of Clinton fossil ore exists at Iron Ridge, about fifty miles north of Milwaukee, Wis.; here the ore soon after mining breaks into grains which, from their shape, size, and color, have given to it the name of "flaxseed ore." Another deposit of fossil ore is reported further north in Wisconsin. The Iron Ridge ore carries such proportions of phosphorus, lime, and silica as to invite attention to it for use in producing steel by the basic process.

The Lake Superior red hematites are of the hard and soft varieties, the Marquette district of Michigan and the Vermilion district of Minnesota showing the former and the Menominee and Gogebic districts of Michigan and Wisconsin exhibiting chiefly the softer varieties, although soft ores may occur among the harder, and *vice versa*.

The noted deposits at Iron Mountain and Pilot Knob, Mo., are speculars with some magnetites, and in the central part of that State excellent soft red hematites abound. Ores of this class are also reported in Arkansas and Texas. Many of the Bessemer ores of the United States are red hematites, but such ores low enough in phosphorus for this process are the exception rather than the rule. The purest of these ores command the highest market rates, being shipped fully 1,500 miles, in some cases, by water and rail. The Chicago, Cleveland, Pittsburg, Wheeling, and adjacent blast furnaces depend principally upon the red hematites of the Lake Superior district, and large shipments are made to Troy, N. Y., and into eastern Pennsylvania.

One of the recognized conditions of an iron ore suitable for the manufacture of Bessemer pig iron is that it shall not contain over one part of phosphorus to 1,000 of iron, but there are cases where ores have been condemned because of an excess of phosphorus, or chemists have been blamed for imperfect analyses, where neither the ore nor the analyst was at fault; but the fuel used in smelting the ore in the blast furnace or in melting the iron in a cupola was credited with low phosphorus when it carried a liberal amount; in fact, where low phosphorus is required, it is as important to analyze the fuel as the ores or iron for this component.

BROWN HEMATITES.

The brown hematite ores are liberally distributed, and are mined in most of the States. The earlier iron industry of the country was sustained principally from the bog variety along the sea coast, but as the settlements extended westward, the use of these lean ores was abandoned.

The Salisbury region, embracing portions of western Massachusetts and Connecticut and eastern New York, has an unrivaled reputation for pig iron for special

* A lecture delivered before the Franklin Institute, December 9, 1887. From the Journal of the Institute.

† Since the lecture was delivered, the statistics of iron and steel production in 1887, issued by the American Iron and Steel Association, have been published, and returns from some of the iron mines or mining districts have been obtained. Therefore, in the text the actual figures for 1887 are given in place of the estimates which were made in the lecture, and the year 1887 is mentioned as last year.—J. B.

* The lecturer indicated on a large map the general position of the various iron ores, and designated the position of the more prominent mining districts.

purposes produced from brown hematites. These ores also abound in the Lehigh, East Penn, Cumberland, and other Pennsylvania valleys, passing thence into Maryland, through the Shenandoah, New River, and Cripple Creek valleys of Virginia into North Carolina, Tennessee, Kentucky, and Alabama, forming in the latter the principal support of the charcoal iron producing industry. To the brown hematites we owe much of the prominence Pennsylvania has won as an iron center, and from them our foundry irons, car wheel metal, boiler plate, and other specialties have been prepared. A widely distributed deposit of excellent brown hematite occurs in Northern Texas and Louisiana, and outcrops of what are apparently hematites along the Mississippi and Missouri and their tributries in Mississippi, Tennessee, Missouri, Iowa, etc., are probably weathered carbonates.

Ores of this class are also obtained in Maine, in Rhode Island, on Staten Island, in Delaware, Maryland, Florida, and other States.

The brown hematite often occurs in connection with the red hematite. As far as has been exploited, the richest ores of this class are in the Salisbury district of New England, in southwest Virginia, middle Tennessee and Kentucky, northern Georgia and eastern Alabama, but some other deposits, but slightly developed, offer favorable indications as to quality.

CARBONATES.

The carbonate iron ores are generally esteemed as the least reliable of all varieties; they have been the main dependence of the Baltimore iron industry, and occur between Baltimore and Washington as kidneys in clay. They were the instigating cause of the establishment of our western Pennsylvania blast furnaces, as at Johnstown and in the Monongahela and Shenango valleys. Ohio has few ores that are not carbonates, and to these ores the large developments of the Mahoning Valley, the reputation of the Hanging Rock region, and the sudden rise into prominence and nearly as sudden decline of the Hocking region is to be credited.

In using this variety of ore, it is generally roasted to drive off the carbonic acid, and other ores are often similarly treated to eliminate the sulphur they contain.

The carbonates are widely distributed, and form an important factor in our iron production. They can be traced through New York, Pennsylvania, Ohio, West Virginia, Virginia, Kentucky, and Tennessee, into Alabama and Mississippi, and are found in Arkansas, Missouri, Iowa, etc.

The black band variety is used to a limited extent, but the cheerful outlook which encouraged a large investment of home and British capital to secure in this country similar results to those obtained from these ores in Scotland was not verified in practice.

MILL CINDER.

In the production of puddled and rolled iron, the resultant cinder which carries off silica, phosphorus, etc., contains from fifty to sixty per cent. iron, and this otherwise waste material is utilized in the manufacture of pig iron by mixing it with natural ores. Owing to prejudice its use is seldom referred to, and yet there are probably not over four mines in the country which contribute so much toward the manufacture of pig iron as this slag or cinder. In some portions of Germany, mill cinder is roasted before it is charged into the blast furnaces.

To a limited extent the residuum from iron pyrites (FeS), after the sulphuric acid is extracted, is used for the production of iron; this is commercially known as "purple ore," or "blue billy," and is employed in Great Britain more than in this country.

RESUME.

It is not presumed that in this hasty sketch all of the iron ores east of the continental divide have been referred to, nor is it possible in the limited time at command to even enumerate the prominent features of the more important ones.*

As mined and supplied to our blast furnaces, the various classes of ores yield about as follows:

	Per cent. iron.	Average per cent.
Magnetites	from 45 to 67	56
Specular and fossil ores (red hematites)	from 35 to 68	57
Brown hematites	from 35 to 55	42
Carbonates, raw	from 25 to 40	32
Mill cinder		54
Foreign ores		53

In 1884, the American Iron and Steel Association determined by careful investigation that, eliminating from the calculation the mill cinder used, the ore employed to produce pig iron in the United States averaged 2 03 tons per ton of iron made, being less than was required in other countries; Great Britain averaging 2 4 tons: Germany, 2·6 tons; France, 2·6; and Belgium, 2·7 tons. Since that time a larger proportion of richer ores have been employed in America, and it is probable that our average consumption is slightly below two tons of ore per ton of pig iron.

It is perhaps unnecessary to remind you that the most important source of our ore supply is from the Lake Superior region, the output of the four districts embraced in it being sufficient to produce forty per cent. of the pig iron which we make. About thirty-six per cent. of the iron ore mined in the United States in 1887 came from that region, and owing to the high percentage of iron in these ores, their aggregate, 4,667,652 gross tons, was sufficient to produce nearly forty-three per cent. of the pig iron made in the United States last year.

FOREIGN ORES.

Next to the Lake Superior region comes the foreign ores, 1,039,433 gross tons having been imported in 1886, and the returns for 1887 show that we received 1,194,301 gross tons. Some of these ores come from our neighbors in Canada and Cuba, but the major portion was from Spain, Africa, the island of Elba, Greece, France, and other countries across the ocean. Notwithstanding the fact that the United States imported more largely than ever before in 1886, and a still greater amount in 1887, the proportionate quantity of foreign ores per ton of pig iron made was, until 1887, less than in 1881, and we to-day use relatively less foreign ores than any of the prominent iron-producing countries, as is exhibited by the following table.

Iron production and iron ore imports in different countries in eight years:

UNITED STATES.

Years.	Pig Iron Made.	Iron Ore Imported.	Average Amount of Ore Imported per Ton of Iron Produced.
1879	2,741,853	284,141	0·104
1880	3,835,191	493,408	0·129
1881	4,144,254	782,887	0·189
1882	4,623,323	589,655	0·128
1883	4,595,510	490,875	0·107
1884	4,097,868	487,820	0·109
1885	4,044,526	390,786	0·086
1886	5,683,329	1,039,433	0·183
Total	33,765,854	4,559,005	0·135
1887	6,417,418	1,194,301	0·183

GREAT BRITAIN.

Years.	Pig Iron Made.	Iron Ore Imported.	Average Amount of Ore Imported per ton of Iron Produced.
1879	5,995,337	1,083,692	0·181
1880	7,749,233	2,634,401	0·340
1881	8,377,364	2,449,277	0·292
1882	8,493,287	3,282,496	0·386
1883	8,490,224	3,178,310	0·321
1884	7,528,966	2,728,672	0·362
1885	7,250,657	2,817,597	0·389
1886	6,870,665	2,875,176	0·418
Total	60,755,733	21,097,621	0·346

FRANCE.

Years.	Pig Iron Made.	Iron Ore Imported.	Average Amount of Ore Imported per Ton of Iron Produced.
1879	1,400,286	941,813	0·673
1880	1,733,102	1,168,215	0·674
1881	1,894,861	1,287,870	0·680
1882	2,039,067	1,425,870	0·699
1883	2,069,430	1,601,217	0·774
1884	1,855,247	1,412,724	0·762
1885	1,630,648	1,419,531	0·871
1886	1,507,850	1,158,581	0·768
Total	14,130,491	10,415,810	0·737

GERMANY.

Years.	Pig Iron Made.	Iron Ore Imported.	Average Amount of Ore Imported per Ton of Iron Produced.
1879	2,226,587	380,000	0·171
1880	2,729,038	607,007	0·222
1881	2,914,009	615,490	0·211
1882	3,380,806	785,360	0·232
1883	3,469,719	800,373	0·231
1884	3,600,612	980,442	0·272
1885	3,687,316	852,714	0·232
1886	3,339,803	812,635	0·243
Total	25,347,890	5,834,029	0·230

BELGIUM.

Years.	Pig Iron Made.	Iron Ore Imported.	Average Amount of Ore Imported per Ton of Iron Produced.
1879	448,371	614,534	1·373
1880	595,704	921,784	1·548
1881	624,736	1,169,206	1·872
1882	727,000	1,206,717	1·66
1883	783,433	1,612,469	2·058
1884	750,812	1,488,140	1·982
1885	712,876	1,393,601	1·96
1886	697,110	1,365,939	1·959
Total	5,340,042	9,772,390	1·83

This table demonstrates that, although our importation of iron ore reached its maximum in 1887, the amount of foreign ore used closely approximated in 1886 the proportion used in Great Britain in 1879, since which date that country has continued to rely on foreign ores to a much greater extent than the United States. The same remark holds true concerning Germany, and France has been more dependent upon foreign ores than any of the countries named, except Belgium, which relies almost entirely upon ores mined outside of its borders.

Taking the average of eight years for the United States, Great Britain and France, Belgium and Germany, and assuming that the average yield of ore, as reported by Mr. Swank, from actual returns made by our blast furnaces in 1884, holds good for the entire period, we have the following:

	United States.	Great Britain	France	Germany.	Belgium.
Tons of ore required to make one ton of pig iron	2·03	2·4	2·6	2·6	2·7
Tons of foreign ore imported per ton of pig iron made	0·135	0·846	0·737	0·230	1·83
Average percentage of foreign ore to total ore used	6·65	14·33	28·37	8·85	67·78

From this it is evident that the United States not only uses a less proportion of foreign ore than any of the other countries named, but the product of our domestic mines averages so well that we need less ore per ton of pig iron than other countries.

We can justly attribute a part of this showing to the influence of the specific duty of seventy-five cents per ton on foreign ores, which undoubtedly encourages a higher average percentage than would be the case if a lower or an *ad valorem* duty was laid on the ores. In fact, we now receive chiefly the best of the foreign ores, for the more valuable the material, the lower the proportionate charge for duty.

PROMINENT IRON ORE PRODUCERS.

Next to the foreign ores, the Cornwall ore hills of Pennsylvania rank as a source of supply, and the company operating this unique deposit, which in 1887 mined 667,210 gross tons of magnetite, is the largest producer of iron ore in the country.

The Lake Champlain district follows next, the product of the mines of magnetic ore sent from Plattsburg, Port Henry, and Crown Point aggregating, in 1886, 663,752 gross tons, and in 1887, 788,084 gross tons.*

To show the relative importance of the various regions, the following statement has been prepared. In it the output of the four districts comprising the Lake Superior region are given separately, and each region is placed in the order of its prominence in 1886. Where data were at hand the actual output, and in other cases estimates of the probable production of 1887 are given:

SOURCE OF IRON ORE SUPPLY BY DISTRICTS.

	Gross Tons. 1886.	1887.
Marquette District, Lake Superior Region	1,621,887	1,836,953
Imported Iron Ores	1,039,433	1,194,301
Menominee District, Lake Superior Region	880,000	1,198,743
Gogebic District, Lake Superior Region	756,281	1,237,704
Cornwall Ore Hills, Pennsylvania	688,054	667,210
Lake Champlain magnetites	663,752	788,084
New Jersey magnetites	500,501	547,889
Missouri mines	379,776	427,785
Ohio ores, carbonates and hematites	344,480	377,465
Vermilion Lake District, Minnesota	304,396	394,252
Cranberry Mines, North Carolina	24,106	45,039

The following estimates are based upon an average yield of ore and pig iron production in 1886:

	Gross Tons. 1886.	1887.
Alabama	670,000	740,000
Tennessee	470,000	600,000
Virginia	380,000	450,000
Georgia	95,000	105,000

It will be noticed that the Gogebic range outstripped the Menominee range in 1887, owing to the unusual activity in opening mines, and that the Lake Champlain district shipped more ore than the Cornwall ore hills in 1887.

The following shows the approximate total production of iron ore to date in prominent mining centers:

Lake Superior Region (thirty-two years)		35,700,000
Of which Marquette District supplied	25,200,000	
Of which Menominee District supplied	7,500,000	
Of which Gogebic District supplied	2,000,000	
Of which Vermilion District supplied	1,000,000	
Lake Champlain Region, N. Y. (eighty-four years)		13,500,000
Of which Port Henry supplied†	8,000,000	
Of which Crown Point supplied	1,500,000	
Of which Chateaugay supplied	2,000,000	
Of which other mines supplied	2,000,000	
New Jersey (about 100 years)		16,000,000
Cornwall (about 140 years)		7,900,000
Missouri:		
Iron Mountain supplied	2,750,000	
Pilot Knob and other mines	1,250,000	

From the Chapin, Norway, and Vulcan mines were won nearly one-half of the product of the Menominee range; while almost seventy per cent. of the output of the Gogebic range came from the Colby, Norrie, Ashland, and Aurora mines.

TONNAGE.

The mining of iron is a business of considerable importance, and to appreciate its volume, we may estimate the railroad traffic which it represents, although all of the ore does not pass over railroads, and much of it reaches the blast furnaces by both rail and water transportation. The majority of the ores from the Lake Superior region are carried by rail to shipping ports, thence by vessel to the lower lake ports, and there rehandled into cars which travel over the railroads to the blast furnaces. Several blast furnace plants are located so as to unload foreign ores at their docks, but most of the foreign ore is transported from the ports where received by railroad cars or by lighters to the points of consumption. A number of our iron works also rely largely on the local deposits, from which the ore is carried by wagons or carts or by wire rope transmission or by tramroad to the furnaces. The proportion, however, of ore which is not hauled over our systems of railroads is quite small, and an illustration of the volume of business based upon the tonnage is a proper one.

Allowing an average load of fifteen net tons per car, which is more probably above than below the actual average, the amount of ore consumed in 1887, viz., 13,063,439 long tons or 14,631,052 net tons, would require 975,404 cars to carry it, or say 32,514 trains of thirty cars each. Five such trains, with motive power and caboose, would occupy one mile of track when standing close together, or the year's product would occupy 6,508 miles of track, a distance equal to twice that from New York to San Francisco.

If all this traffic passed a given point, there would be eighty-nine trains per day, or a train every sixteen minutes during the year.

The traffic of the Pennsylvania Railroad in 1887, as exhibited by the annual report, shows a total tonnage of through freight of 6,278,628 long tons, or less than one-half of the total amount of iron ore as above, and the local freight (43,754,669 long tons) is about three

* During the lecture a number of lantern slides were exhibited, reproductions of photographs of numerous prominent iron mines, showing the extent of the deposits and the methods of working them, etc. A geological and topographical model of the Cornwall ore hills of Pennsylvania was also shown.

* Messrs. Witherbees, Sherman & Co., the largest individual firm of ore producers in the country, offer for sale, in 1888, 375,000 tons of ore from the mines near Port Henry, N. Y.

† Six Marquette mines, viz., Lake Superior, Cleveland, Republic, Jackson, Champion, and New York, produced over sixty per cent. of the total output of this district.

times as great, so that the iron ore carried by the different railroads in the United States in 1887 would represent nearly thirty per cent. of the entire freight traffic of the Pennsylvania Railroad and branches for the year.

If now we estimate the labor required to mine the ore, load it on cars, and transport it to destination, we see the importance of this industry, which employs over 50,000 men. But the mechanical appliances used are features of interest, and the hoisting engines, pumps, air compressors, rock drills, washers, and jigs connected with our mines have greatly influenced the advance in mechanical skill which has marked the development of our country.

The tabulated figures presented in this paper indicate the sources from which much of the iron ore is obtained, and from these figures we find that, of the estimated output of iron ore in 1887, the following approximate percentage came from—

	Percentage of total output.
Lake Superior Region	37—
Foreign ores	9
Alabama, estimated	6—
Cornwall Ore Hills, Pennsylvania	5
Lake Champlain District	6
Tennessee, estimated	5—
Ohio	3
New Jersey	4
Virginia	4½
Missouri	3½
Salisbury Region	1—
Georgia, estimated	1—

From these figures an approximate estimate of the value represented by the iron ore shipment of any one source of supply can be made. As the ores vary in the yield of iron, it will be of interest to place them in something near their relative rank by estimating the probable percentage of the total amount of pig iron which these ores produced.

	Per cent.
Lake Superior ores	44
Foreign ores	10⅕
Lake Champlain ores	6½
Cornwall ores	5—
Alabama ores	5—
New Jersey ores	4½
Tennessee ores	4
Missouri ores	3½
Virginia ores	3—
Ohio ores	2⅕
Salisbury Region	1—
Georgia ores	½—

The strikes in the anthracite coal regions and in the coke regions during the year materially reduced the demand for ores, and curtailed the output of some of the important Eastern districts, such as the Lake Champlain, Cornwall, and New Jersey mines.

The bulk of the hematites of Pennsylvania, of which we still have large deposits, are but little inferior in the yield of iron, and many are otherwise superior to the Southern ores, and our magnetites and those near us in New Jersey, together with the facility of drawing upon Lake Superior and foreign countries for their best ores, place Pennsylvania in position to hold her status, and the question of the Keystone State maintaining its pre-eminence as an iron producer rests entirely with those who manage and control its furnaces.

IMPROVED GAS MOTOR FOR STREET RAILWAYS.

THE Connelly motor is a gas motor, carrying its own store of fuel for a day's run, and the fuel used is the heaviest grade of naphtha which will not vaporize at the temperature of the atmosphere. It is carried in a closed tank, which is again inclosed in the radiator, filled with hot water constantly furnished by the engine cylinder. The radiator performs an important double service, cooling the cylinder of the engine and warming the carbureter. The circulation of water from the cylinder to the radiator and return is continuous. The inner vessel or carbureter is filled with an absorbent material, which absorbs the charge and leaves no liquid to be lost should a leak occur; the only effect of an opening being sprung in the cylinder, from any cause, would be the admission of air through it instead of through the check valve, its regular inlet. Air is drawn automatically through the absorbent material, thoroughly carbureted, and supplied to the engine in exact proportion to the power required. There is not the least element of danger attending the operation of this system.

This is the invention of John S. Connelly, of Brooklyn, N. Y., to which improvements have been added, and a very complete and promising form of motor is the result, suitable for street cars and other vehicles.

Only those familiar with the great power required for a few seconds to start a loaded car on a heavy grade (10 horse power), and the weight of ordinary gas engines of such power, can fully appreciate the difficulties encountered in this undertaking.

"Necessity is the mother of invention," and the result in this case is the construction of a compound gas engine having one-third the weight of any other gas engine of equal power, and consuming 25 per cent. less gas in performing the same work.

The principle of all gas engines is such, their speed cannot be varied like the steam engine, but must run at a nearly uniform rate. Therefore, special mechanism was required for transmitting power to the axle at any desired rate of speed. It was absolutely essential to complete success that this should be accomplished, and in such a manner that the speed of the car could be varied at will of the driver by moving a single lever. The mechanism employed for this important service is positive in action, noiseless, and most durable. The wearing parts are easily, quickly, and cheaply replaced. It prevents giving shock or jar to the car when starting, and, above all other advantages, transmits maximum power when driving car at minimum rate of speed. In the transmission of power by friction, it is necessary that the contact pressure should vary in proportion with the power transmitted; this is accomplished automatically by means of a right and left screw nut, operated by an eccentric extension of the hand lever, so that any movement of the lever in either direction, to vary the speed, changes the pressure of contact correspondingly, thus securing maximum pressure on grades or curves, and minimum when running at full speed. This is one of the most important features of the device, as it would be impracticable to run at full speed with the same contact pressure that is required when starting on grades or curves. Such a device is absolutely indispensable in applying a gas engine to this purpose, and patents have been granted covering broadly all the important features of this invention. Its use dispenses with numerous levers that would otherwise be required, and the advantage of having a single lever for giving any desired speed, most simple design, attached to and operated by the engine, easily controlled by the driver, requiring the least touch to bring it into action.

The cost of operating street cars with horses, including feed, shoeing, care, depreciation and death loss, but exclusive of wages of driver and conductor, averages from five dollars to six dollars and a half per day for each two-horse car.

The cost of operating the Connelly motors per day (14 hours) each, is as follows: Fuel, 14 gallons at 5c., 70c.; lubrication, 10c.; care (engineers), 35c.; repairs (wear and tear), 25c. Total cost per day, $1.40.

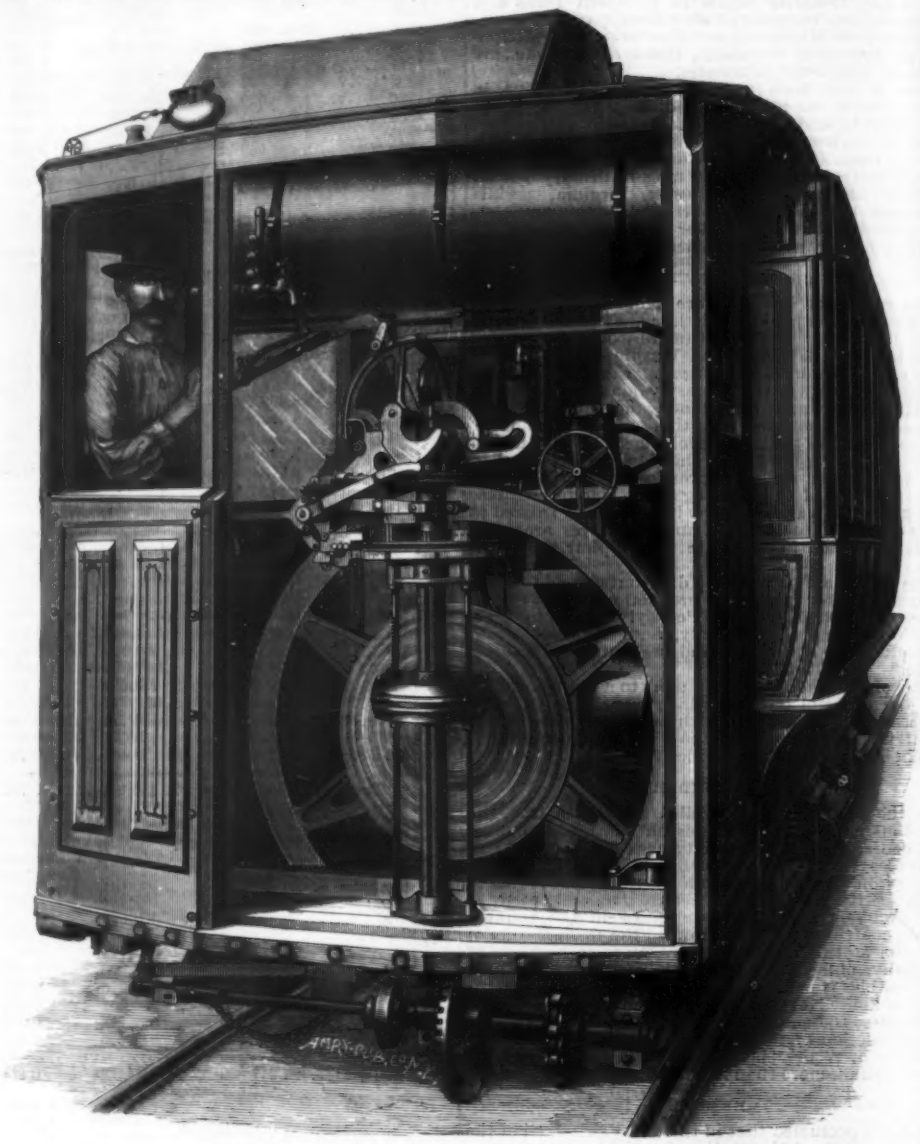


FIG. 1.—THE CONNELLY STREET CAR GAS MOTOR.

either forward or backward, will be apparent. The average car driver is fully competent to control a car by a single lever, whereas a number of levers would be confusing, and necessitate the employment of a higher grade of labor. The only engineer, or engineers, needed is at headquarters, to examine and inspect the motors, as they come into the car shops at night.

The special mechanism employed to vary the speed of the car transmits power to countershaft under the platform by noiseless cut gears. The countershaft and front axle are connected by a link chain, all the machinery works in perfect harmony, the transmission device communicating power to the car at any speed or when starting, without noise, shock, or jar.

The engine emits no smoke nor odors, the exhaust gases passing off above the roof of the car.

As much higher speed can be attained—where permissible—than by the use of horses, it becomes important that the brakes should be operated by the engine to insure prompt stopping when at highest speed. The motor is accordingly provided with a brake of the

This estimate is based on actual running in vicinity of New York. But in the extreme West or South, where the fuel costs 10 cents per gallon, the cost would be increased 70 cents per day per motor.

It is obvious, if these results can be realized, the days of horse railways are numbered. The invention is now under the control of the Connelly Motor Co., 177 Broadway, New York. The company furnishes motors complete, on a fixed yearly rental, guaranteeing the cost of operating the motors, including rental, fuel, lubrication, care, and repairs to motive machinery, shall not exceed two-thirds the cost of operating with horses doing the same service. In many cases the cost will not exceed half the expense attending the use of horses.

Fig. 1 gives a front view of the car, with portion of cab removed, exposing engine, storage tank, main shaft and gearing.

Fig. 2 is a side elevation of the car, showing countershaft for transmitting power to the car axle.

Fig. 3 is a cut of the compound gas engine, showing the high and low pressure cylinders placed at right

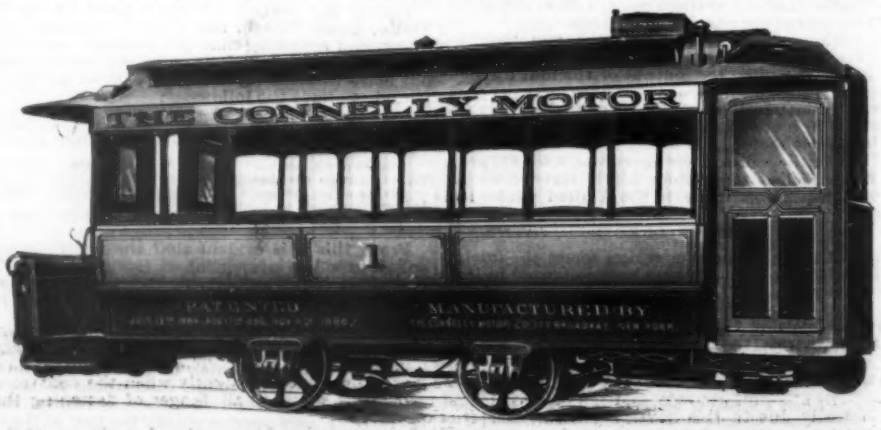


FIG. 2.—THE CONNELLY STREET CAR GAS MOTOR.

angles to each other, the upper one being the high pressure cylinder.

The fuel tank is a double cylinder, the inner one containing the naphtha and an absorbent material; this is surrounded by a jacket of water, which is connected by pipes to the water jacket about the high pressure cylinder.

The circulation of the water from the cylinder to the radiator is continuous, and it performs a double service, cooling the cylinder of the engine and warming the naphtha, producing evaporation.

Air is drawn through the absorbent material, thoroughly carbureted, and supplied to the engine compressed, and then ignited by an electric spark. The low pressure cylinder next receives the charge and becomes a motive cylinder during the first half of the outstroke, when, the pressure being gone, it acts as a pump during the last half of the outstroke, drawing a fresh charge of gas into the high pressure cylinder. The exhaust passes through pipes under the floor of the car to the condensing tanks, and then by a pipe out above the roof of the car.

Fig. 4 shows the device for transmitting power to the main shaft at any rate of speed, with the engine running continuously at a uniform rate, and the success of the motor is really due to this novel, ingenious, and simple mechanism.

The main shaft is set parallel with a disk 2 in. in diameter, placed on the face of the fly wheel. On the shaft is a loose friction pulley 12 in. in diameter, that engages with the face of the disk. This loose pulley is prevented from revolving on the shaft by a tongue and groove, but it may be moved up or down on the shaft at the will of the driver, by means of two screw rods, which pass through the pulley and revolve with the shaft.

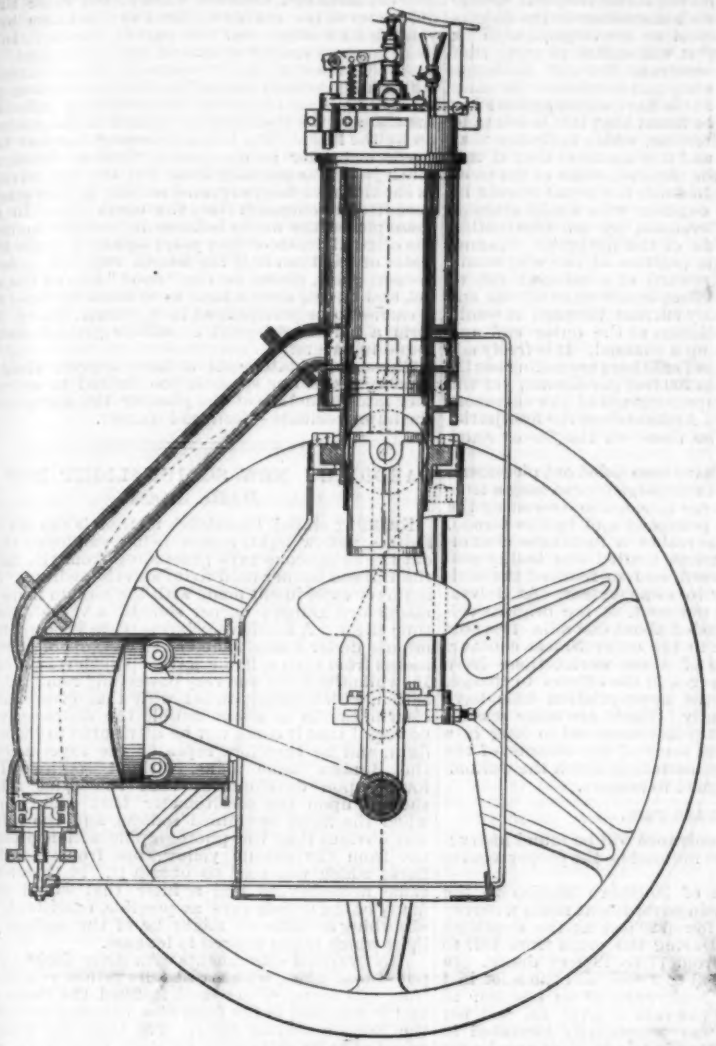


FIG. 3. THE CONNELLY MOTOR.

When it is required to slow up or stop the car, the friction pulley still in contact with the disk is run down to near its center.

To reverse the car, the friction pulley is run below the center of the disk, while the engine is permitted to run all the time at a uniform speed in the same direction. The engine requires no attention after being started, and regulates its own speed, whether the car be running or standing still. To start the car, the contact of the pulley with the disk is always made near the center, so that the car is started with a gentle motion, and with an enormous leverage. In rounding curves, or in ascending steep grades, the contact may be maintained near the center, thus securing sufficient power under all conditions. The friction pulley has a loose band that revolves slightly when the contact is first made, thus avoiding all danger of flattening the friction pulley.

Fig. 5 shows the hand levers placed on the top of the main shaft, and which serve to hold the friction pulley firmly against the disk, or release it, and also to move the pulley up or down on the shaft.

Fig. 6 shows small spur wheels on the ends of the screw rods, which mesh into cogs on the inner surface of the grooved pulleys, shown in Figs. 4 and 5. By checking these pulleys with a friction brake, the screw rods are made to turn, and so carry the friction pulley to any point on the disk. The main shaft transmits power to a countershaft under the platform by noiseless cut gears.

The countershaft and front axle are connected by a roller link chain.

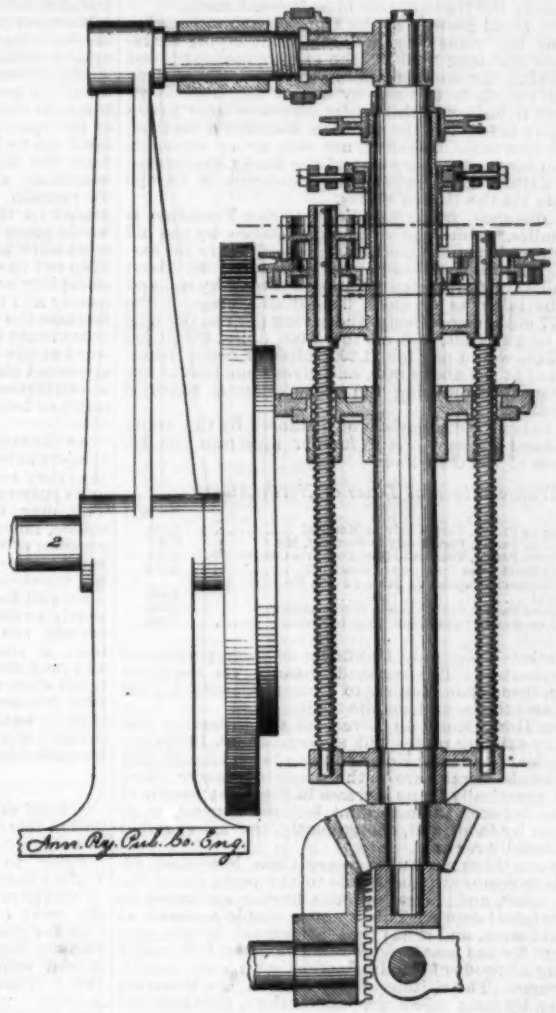


FIG. 4. THE CONNELLY MOTOR.

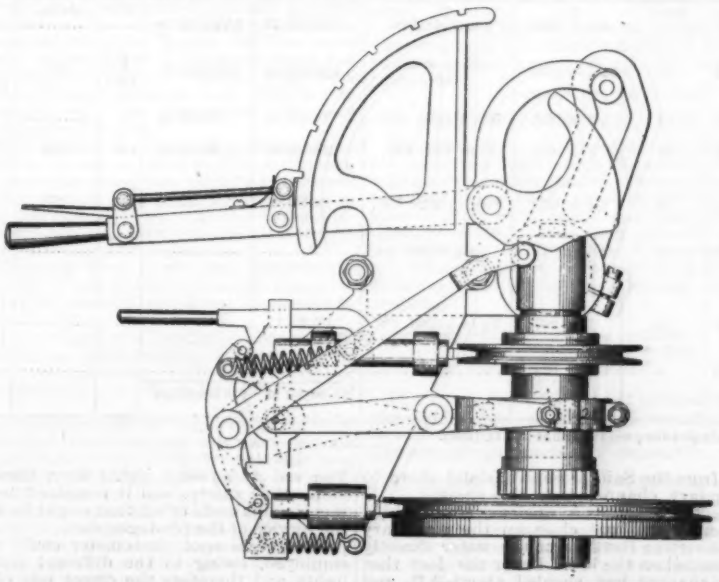


FIG. 5. THE CONNELLY MOTOR.

THE NEED OF THE SOUTHWEST—A DEEP WATER PORT FOR TEXAS.

By LEWIS M. HAUPT, C.E.

In these days of trans-isthmian agitation it becomes interesting to recall the early history of the Spanish occupation of that portion of the country then forming a part of Mexico. The engineering projects of to-day contemplate the passage of the isthmus by two waterways and one ship railroad; but before steam became a potent factor in transportation, and when animals were the principal means of locomotion, an active interoceanic trade existed over the portage extending from Corpus Christi Bay on the Gulf of Mexico to San Diego on the Pacific Ocean. Numerous relay stations of adobe were built on this line, some of which are still preserved as shrines for the service of devout Catholics.

FIG. 6.

Built by unskilled labor and of the crudest kind of material, they are wonderful monuments of endurance and exhibit great fertility of resource on the part of the missionaries who are supposed to have designed and executed their construction more than three centuries ago. But this chain of missions has more than an engineering or historic interest. It is strategic. These cathedrals were also fortresses and trading posts,

placed on the line which, in those days, commanded the largest tributary country, was the most salubrious, and which could be readily traversed. This route connected the nearest deep water port on the Gulf with that on the Pacific. To-day the physical conditions are substantially unchanged, excepting that the unceasing southward progression of the sandy islands inclosing the lagoons of the Texas coast has caused the harbors to deteriorate to so great an extent as practically to close and barricade the eastern entrance and destroy the trade of this once favored route.

In the rapid growth of the trans-Mississippi region the time has come when its citizens are crying for relief from the long haul to the eastern seaboard, and are looking for and demanding the opening of their natural outlets to the sea by way of the Gulf coast. The area tributary to this outlet embraces over 1,000,000 square miles, and the question assumes a vast national importance, therefore, not only as an economic problem for the territory east of the Rocky Mountains, but as a trunk line between the continents of Europe and Asia via the United States.

The distance from New York to San Francisco is 3,250 miles,* while the overland distance by the old Spanish route is but about 1,200; consequently the saving in rail transportation may be reduced by about 2,000 miles. If the relative rates on cereals by rail and ocean be taken as the basis, then at an average of 5·08 and 0·77 mills, respectively, the saving per ton per mile would be 4·31 mills, and on the 2,000 miles, $8.20 per ton. This would pay for 11,200 miles of ocean transportation at the above rate, and gives some idea of the importance of reducing the rail distances wherever practicable.

The following comparison of distances by the transcontinental routes will still further illustrate the advantages of the Gulf line:

Transcontinental Lines of North America.

	Miles.
Canadian Pacific, Port Moody to Montreal	2,904
Canadian Pacific, Port Moody to Portland, Me.	3,301
Northern Pacific, Tacoma to New York (via Cascade Div.)	3,253
Union Pacific, San Francisco to New York	3,318
Via Atchison, Topeka & Santa Fe (San Francisco to New York)	3,463
Southern Pacific (San Francisco to New Orleans)	2,495
Gulf or Mexico Pacific (San Diego to Aransas), about	1,200

The latter being only two-fifths or forty percentum of the shortest. The overland distance, via Southern Pacific, from San Monica to Corpus Christi is 1,600 miles, and this would get the traffic.

From Hong Kong to Liverpool the estimated distance by existing routes will average about 12,000 statute miles.* As Hong Kong, the Sandwich Islands, and the Florida Straits are on the tropic of Cancer, there would practically be no increase in the total length of the line between these termini, but the percentage of distance by land, and, consequently, the rates, would be materially reduced.

The one thing needful to secure these important results is to remove the barricade to the ports along the Texas coast, and to restore the harbor entrances to their original depth. This is not so simple a matter as it would seem, and it has been attempted by the government for the past twenty years or more, but, under existing methods of administration, with little practical success. The citizens of that section are therefore moving, by mass meetings, conventions, publications, and petitions, to obtain a more energetic application of a portion of the surplus to these legitimate and greatly needed improvements.

As an engineering problem it may be of interest to note some of the physical conditions existing at the several points on the Texas coast where it is thought suitable harbors might be obtained. For this purpose the appended tabular exhibit, prepared for the Fort Worth convention, will show in the most succinct manner the main elements with sufficient accuracy to convey a fair idea of their relative importance and the success thus far attained, with the amounts expended and estimated to complete.

This table contains much food for reflection, but there are several points which it demonstrates forcibly. The first is that the area of the fresh water basins in this section has little or no influence in maintaining the depth over the bar. Second, that the area of the tidal basin inside the gorge, as well as its form and the position of its outlet, are important elements in the problem. Third, the comparative surveys also show the existence of a resultant force which causes a southerly movement of the passes at a rapid rate, and which furnishes a key to the speedy solution of the problem. The table also gives a direct answer to the questions as to the proper location of a safe and commodious harbor which can be obtained at least cost, in least time, and be most cheaply maintained.

The present resources of the profession in creating channels over bars appear to be limited to jetties, aided by dredging, sluicing basins, tidal reservoirs, and other expensive works, which have invariably resulted in extending the jetties and requiring frequent dredging. Without entering into a discussion of the defects and difficulties in the parallel or convergent, high or submerged jetty systems,* it will suffice to state that they are intended to concentrate the ebb discharge upon a certain part of the bar and so remove the sand which the flood tide and waves have rolled against the inlet. In general, it will be found that this beach sand is moved in a resultant direction, which indicates that of the controlling forces, and it is manifest that if this sand can be kept out of the channel, while at the same time the flood tide is admitted, the result should be beneficial; also, then, an engineer who would attempt to restrain the sand movement by an obstruction placed on the farther side of the navigable channel would place himself in the position of one who would erect snow fences to the leeward of a railroad cut to keep out the snow. The effect would be to fill the cut as rapidly as possible. Any current through it would merely add to the accumulation at the outer end and increase the cost of creating a channel. It is freely admitted that the sands of the Texas bars are rolling southward at the rate of at least 200 feet per annum, yet the approved plans for the improvements of the entrances at Galveston, Cavallo, and Aransas show the first jetties built, or being built, to be those on the *far or south side.*

As the appropriations have been doled out piecemeal, the jetties have remained submerged for so long a time that they have been in large measure destroyed by the cross currents they have produced and by the teredo. This may be regarded as rather a fortunate circumstance, however, since it has limited the bodily progression of the bar gulfward, and so reduced the ultimate length of the jetty to some extent. At Galveston the shrinkage was 61 per cent. of the original volume, and the bar has receded about one mile. It is now nearly or quite five miles to the outer 30 feet contour. During the continuance of these works, there have been at least three changes in the officers in charge, and probably more, and the appropriation bills have failed even more frequently. These are some reasons why this section of country has remained so long in a state of nature, and reveal some of the defects of the present methods of administration which the Cullom-Breckenridge bill is designed to remove.

ARANSAS PASS.

A brief sketch of this entrance will be found instructive in this connection, as indicating the proper course to be pursued.

Prior to the cession of Northern Mexico to the United States, the Mexican government made a survey of this port in 1832, and found 20 feet as the depth on the crest of the bar. During the years from 1837 to 1839 the pilots reported from 17 to 18 feet depth. In 1868 the depth had receded to 9 feet, and the inlet had moved some 2½ miles southward of its position in 1839.† This would be at the rate of over 400 feet per annum. "The depth was temporarily increased in 1869 by placing obstructions in the N. E. channel over the bar, but subsequently decreased, until 1878, when the Morgan ships were withdrawn, being unable to cross the bar." The *obstructions* of 1869 contain an important sequel which appears to have escaped attention, for in reporting on this pass Captain Howell says:‡

"In 1869 work was begun by private enterprise to improve the channel through the bar by running out lines of jetties from the Saint Joseph's Island shore to cut off a secondary channel near this shore. . . . They were expected to act as a nucleus, about which sand would accumulate and close up the secondary channel, thus diverting the flow of the water directly through the channel on the bar. From the fact that the secondary channel had shoaled about 2 ft. and the main channel had deepened about 2½ ft. since placing the crates, it may be supposed that they have contributed to produce this result."

In commenting on this extract, a board of engineers say (page 1260):

"It is stated that a pier of 600 ft. in length, constructed in 1869 from the end of Saint Joseph's Island, caused the temporary deepening of Aransas bar. It is not clear how such effects could be attributed to the structure, unless, as Lieut. Woodruff reports, it was instrumental in closing a swash channel then existing."

Thus this short 600 ft. jetty on the *north* side, built of "crates" and at private expense, did produce a beneficial effect by obstructing the sand moving southward into the main ebb channel, while at the same time it did conserve the energy of the ebb discharge by preventing its wasting over that part of the bar. In fact, its action was similar to that of the "stone fleet" sunk on the Charleston bar to obstruct the entrance, and which unexpectedly resulted in forming a new and better channel than before by the protection afforded to the ebb and the resistance it opposed to the sand rolled up by the flood. The lesson, however, was lost to the government, for in continuing work at Aransas the south jetty was partially built and the bar advanced, as should have been expected so long as the sand was permitted to encroach from the north side. In all of these places, the writer believes it possible to recover the original depth of fifty years ago by a single breakwater of less than half the length required under the present plans, placed on the "flood" side of the channel, and having such a form as to cause the sand which it carries to be precipitated in a pocket, where it will form a harmless deposit or middle ground such as is found in nature.*

These brief statements of facts suggest their own conclusions, as our space is too limited to enter further into the details of the plans or the necessities for the improvements.—*Railroad Gazette.*

Name of River Basin.	Tributary drainage area in sq. miles.	Relative area.	Area of inner bay or tidal basins.	Relative area of tidal basins.	Name of pass.	Width of pass.	Mean rise of tide.	Distance to crest of bar.	Dist. from mouth of river to "gorge" of bay.	U. S. C. S. Depth on outer bar in ft., referred to mean low water.	According to latest surveys.	Total expenditure.	Estimate of cost to complete.	Predicted resulting depth.	Harbor capac. inside of gorge having depth of 20 ft.	Results. See Appendix T, Report of the Chief of Engineers for 1887.
			Sq. miles.			Ft.	Ft.	Miles	Miles.	Ft.	Ft.			Ft.	Acres.	
Sabine River	22,000	1.44	.....	.....	Sabine Pass	2,100	.....	2.70	.....	6¼ in 1884.	8 in June, 1888.	$507,068.77	$2,301,250.00	.....	.....	.....
Trinity River	24,500	1.62	450	2.25	Galveston	9,000	1.1	4.00	17	12¾ in 1884.	12¾ in March, 1887.	1,581,782.84	6,700,000.00	25 or 30	270	It has resulted in deepening the water over the outer bar to about 12¾ ft.
Brazos River	38,500	2 54	.....	.....	Brazos River	600	1.1	0.38	0	8 in 1858.	5½ in April, 1887.	140,833.94	384,000.00	.....	.....	"It has not as yet resulted in any useful effect upon the bar."
Colorado River	37,000	2.42	Ab't 500	2.50	Pass Cavallo	9,000	1.1	2.00	16	8 in 1874.	10 in July, 1887.	290,095.16	1,366,780 00	12	1,350	
S. Antonio River	15,000	1.00	200	1.20	Aransas Pass	3,000	1.1	0.75	25	6¼ in 1875.	* 8½ in May, 1887.	393,556.95	1,571,293.72	12	250	"It has resulted in checking the southward movement of the pass."
Nueces River	17,800	1.18	220	1.25	Corpus Christi	1,300	.....	1.00	34	.....	4½ in 1887.	.....	.....	.....	.....	Nothing has been attempted at this point.
Laguna de la Madre	.....	.....	.....	.....	Brazos Santiago	1,200	0.7	0.50	60	7 in 1867.	7½ in August, 1887.	185,204.17	....	.....	.....	"It has not as yet resulted in any useful effect upon the bar."
Rio Grande	387,500	19.00	.....	.....	Rio Grande	600	0.9	0.50	0	3 in 1854.	.....	.....	.....	.....	.....	.....
												$3,099,141.83	$12,303,323.72			

* Texas papers give the present depth at 10½ ft. (1888).

GAEDICKE'S NEW SODIUM LIGHT FOR THE DARK ROOM.

BRIEFLY stated, Gaedicke's method is the use of the sodium yellow light, means being employed to filter out the extraneous rays proceeding from the flame of the Bunsen burner used to inflame the sodium. A preliminary experiment made with the sodium flame in an unshielded Bunsen burner showed a very decided actinic effect. A sensitive gelatine plate exposed for one minute under a sensitometer at a distance of about 13½ inches from such a flame gave upon development No. 11, while the No. 8 was very powerfully rendered. This action, which corresponded with that given out by a stearin candle at about double the distance, was so powerful that it could not be attributed to the sodium light, and he therefore repeated the experiment with the Bunsen flame alone, without sodium. It was found upon development that the same numbers showed upon the sensitometer that had appeared when the flame contained sodium, and the inference was obvious that the photographic action proceeded, not from the sodium yellow, but from the Bunsen flame which was used to obtain it. It therefore became necessary to find a filter that would stop as many of the actinic rays as possible, consistently with absorbing as little as might be of the sodium yellow light which it was desired to let pass.

After various experiments with silver flashed glass, a pot metal glass, which owed its yellow coloration to iron, was found, which well fulfilled the desired end, and it was used in the form of a chimney surrounding the Bunsen sodium flame. The lamp was then compared as to its suitability for dark room work with a petroleum lamp supplied with a chimney of dark ruby-colored glass.

The two lamps gave at an equal distance from the sensitometer screen (13½ inches), the same distance as that with which the first experiment with the unprotected Bunsen was made after one minute's exposure, a barely visible image of No. 1 of the sensitometer screen. The red and yellow lights were, therefore, equal in non-actinic safety, and it remained to be seen what was the luminous effect that might be made use of in the service of the photographer.

The grease spot photometer could not properly be employed, owing to the different colors of the two lights, and therefore the direct test of the ability to read type of a certain size at varying distances from the sources of light was brought into requisition. It was found that the printed paper could be read at a distance three times as great from the yellow light as it could from the red, showing nine times as much illuminating power to the eye for the yellow as the red, while the safety of the plate against photographic action was the same. It might also be put in

* Post Office *Guide.*

* See Franklin Institute *Journal*, April, 1888.

† See paper on "The Deep Water Port of Texas," by Col. G. W. Fulton, published in the Denver *Chamber of Commerce*, July 7, 1888.

‡ Report Chief of Engineers for 1880, vol. ii., pages 12, 61, *et seq.*

* "The Physical Phenomena of Harbor Entrances: Their Defects and Remedies," published by the American Philosophical Society, Phila.

another way, that if a certain amount of luminosity was necessary for working by, the operator might, while confining himself to that quantity with either light, have nine times less photographic or fogging action upon his plates when working with the yellow light than when using the red.

Spectrum analysis of the two lights showed with the red a range from the extreme red through the orange, and included the yellow; while with the yellow, only the sodium line was visible, and the light might be truly called monochromatic, and Gaedicke therefore calls the lamp a monochromatic dark room lamp, and as such it is now a commercial article in Germany, being made in two forms, one for gas and another for spirit where gas is not available.

An incombustible wick is placed in the Bunsen flame. This wick is prepared by being moistened, and then dipped into some sodium salt. It is necessary to renew this application daily if the light is constantly used.

For developing, the monochromatic lamp is stated to be superior to the red, in that the intensity of the image can be so much better determined, owing to the visual illumination being nine times greater than with the red lamp, while for the dry plate factory there is the correspondingly greater ease with which defects in the plates can be discerned, or if preferred, the same visual power of light may be employed, and the light will be nine times safer than when using ruby light. In addition, there is also the greater comfort and freedom from feeling of strain upon eyesight which most at all events feel when working in a yellow light as compared with a red one.—*Photo. News.*

PROGRESS OF PHOTOGRAPHY.*

By W. H. H. CLARK.

IT has been my misfortune to be selected by your executive committee to present you with a report on the progress of photography during the past twelve months. If I do not report anything very astonishing, you must charge it to one of two things, perhaps both, namely, that photography has progressed so gradually, and the task of formulating a report of its progress during the passage of one short year has been so difficult, or else your committee has made a grievous mistake in their appointment.

I will be as brief as possible, endeavoring to make myself heard by the farthest member in the hall. Therefore what I lack in enlightenment I will endeavor to make up in noise.

Photography may now be divided into several distinct departments—portrait photography being confined to professional artists who earn their living by their business; landscape photography, followed by professional photographers and amateurs; scientific photography, practiced for the most part by salaried men, but quite freely indulged in by amateurs; photomicrography, properly included under the above heading; and stellar photography, which is directed to the object of discovery in the realms of space, heretofore explored only by the telescope, and mapped by drawings made by hand.

Stellar photography has made considerable progress. The governments of the world have taken it under their patronage, and we may look for wonderful developments in this direction, or at least our great-great-grandchildren may. There will be placed in observatories in different parts of the world, ten instruments of about eleven inches in diameter and about twelve feet focal length, for the purpose of photographing and mapping the heavens; when the parts are placed together, the whole will comprise a complete photographic map of the starry universe. As these instruments will be controlled and operated by men of undoubted zeal and ability, great things are hoped for.

Orthochromatic photography has made some advance yet not so great as it should have done, or that it will do in the twelve months to come. Photographers have been slow to appreciate its great advantages. Orthochromatic gelatine dry plates are now on the market, possessing good keeping qualities and of extreme sensitiveness. Dr. Albert, of Munich, publishes a formula for orthochromatic collodion emulsion, which is said to produce plates as sensitive as any gelatine plates now on the market, are of easy preparation, and can be used wet or dry. Should all this prove upon trial what is hoped for it, photographers can have the pleasure and profit of making their own plates, as in the old wet collodion days. Plates prepared orthochromatically are invaluable for many purposes, and desirable for all.

In the direction of photo-mechanical printing there is little progress to record, so far as quality is concerned, the proofs of to-day being but slightly in advance of a year ago, but there is a marked improvement in the demand for this class of work. As the demand increases the quality will also increase, and uses will be found for them not thought of at present.

Eastman's stripping films have been introduced, which have nearly, if not quite, superseded paper for negatives, and which obtain a very great advantage in photo-mechanical printing.

I can report no progress in portrait photography. The suicidal policy of price cutting, adopted by the leading and well-to-do galleries, to kill out their poorer neighbors, has produced evil effects, and poorer work is the result.

Instantaneous photography at night by aid of artificial light has many devotees, and not alone among amateurs. Magnesium in some form or other has been the main source from which the light has been obtained, and many and varied are the devices put upon the market for flashing the powder. Of late a new candidate has made its appearance, which bids fair to outrival all others. I refer to the nitric oxide gas flash, of which mention has been made in the different journals. It produces no smell or smoke.

Diffraction photography, the name given by Dr. John Vansant to photography without a lens, is receiving considerable attention, and is destined to prove of great value in the arts and sciences.

In photographic objectives two recent improvements are by Messrs. Voigtlander and Dallmeyer. The former having constructed a new portrait lens, one of the chief merits of which is that it is absolutely rectilinear, and is said to be the first rectilinear portrait lens ever placed upon the market. The glasses of both front and back combinations are sealed, so that all diffusion and loss of light by reflection is successfully overcome. The focus is longer than heretofore, which enables the operator to pose his sitter farther from his instrument than has been his wont, thereby securing portraits which excel in correct and faithful reproduction of the features, brilliant and equalized illumination, true perspective, and perfect definition, together with that round, soft, stereoscopic effect which delights the eye of every true artist. Photographers who do much at viewing have observed the fact that, while their single lens would give fine brilliant negatives of forest, rock, and river views, architectural work required a different instrument. Thanks to the advance made in the construction of photographic objectives, one lens will now accomplish all the above to the entire satisfaction of the most critical, Mr. Dallmeyer having invented and placed upon the market a single lens, which is absolutely rectilinear, producing great brilliancy and no "lapping lines." In this new lens, the concavo-convex and one meniscus are fitted together, while the second meniscus is reversed, so that a double convex space (if such a term is admissible) is left between them. The lens sets back in the tube with the diaphragm in front; the angle is about sixty-five degrees.

In developers several new substances are being put forward for developing the latent image on the exposed plate, foremost of which appears to be hydrochinon, as that chemical possesses good keeping qualities and is energetic to the last drop. We may look for it to become a general favorite. Another thing in its favor is that it can be prepared and used as a one-solution developer, preparations of the kind being already upon the market. It will be well for photographers to give hydrochinon a trial.

Self-developing dry plates are now manufactured, upon the backs of which is a coating of some kind that holds a prepared pyro developer. Therefore, all that is necessary, after the plate has received the proper exposure, is to immerse it in a dish of pure water. Of the practicability of such a mode of working I am a little skeptical. Photographers having learned how to better fix their negatives, there is less complaint of deterioration, and more durable negatives are the result.

Concerning plain paper there is a tendency among photographers to return to its use for contact printing, in order to do away with the so-called inartistic polish of the albumen surface. It is more strongly advocated in foreign countries, and more largely practiced. Albumen paper, however, will continue to be used, at least, for another twelve months.

The metric system, although not alone pertaining to the progress of photography, yet is a subject agitating the minds of the fraternity the world over, and many of our best formulas are published in that system; therefore a remark or two upon this subject may not be out of order. While I shall not advocate either the metric or our own system of weights and measures, still there is great room for improvement in the latter. A commission has been appointed to meet in this country for the purpose of adopting some means whereby the metric system shall be put into more general practice in the United States. This commission will meet some time during the present year. Perhaps it would not be out of place for this convention to give expression upon this subject.

Schools for Photography.—Germany has taken the lead in establishing schools, or more properly speaking colleges, of photography, one in Berlin, in charge of Dr. H. W. Vogel, and another in Vienna, in charge of Dr. Eder. These colleges are supported by the government, the price of tuition being very small. Large and handsome buildings have been erected for that purpose, containing departments for every branch of the photographic art, where pupils can secure a thorough practical as well as theoretical knowledge of the business in all its branches, or those only that he or she may elect to study and practice. It is to be hoped that some influence will be brought to bear upon our government, whereby some of the surplus millions now in the treasury might be applied in the same direction.

The photographic journals remain about as they were one year ago, shedding abroad their light among the hive of workers, that all who wish may improve themselves.

* A paper read before the ninth annual convention of the Photographers' Association of America, held at Minneapolis, Minn., July 10 to July 14, 1888.

NON-CROCKING BLUE ON COTTON.

HENRY & COMPANY propose the following process for producing blues which will not crock whites.

The cotton is first boiled twelve hours in a pressure keir containing a soda solution at 2° B. The cotton is then washed with water and dried slowly at a temperature of 110° F., and then allowed to cool. The dyeing is divided into two distinct operations.

1. The material is immersed in small quantities in a bath made by mixing two solutions. The first is thus prepared:

(*a*) Chlorate of potash 8 pounds.
Sulphate of copper 14 pounds.
Sal ammoniac 14 pounds.

The whole is dissolved in 25 gallons of boiling water, and eight pounds of nitrate of iron of 48° B. are added, and then 40 gallons of cold water and the mixture kept. The second solution is thus prepared:

(*b*) Aniline oil (toluidine or xylidine also) 12 gals.
Muriatic acid 6 gals.

These are worked together for fifteen minutes, and then six gallons of cold water added, followed by eight pounds of tartaric acid dissolved in 25 gallons of boiling water.

The first dye bath is prepared by thoroughly mixing one part of *a* and two parts of *b* at the moment of use.

The cotton is then introduced in small quantities, two pounds at a time, worked properly, and wrung four to six times after shaking out twice on the stick. The partially exhausted bath is strengthened by the addition of ⅓ of its volume of *a* and ⅔ of *b*, and is then ready for the treatment of a second lot. The cotton taken from the bath is dried upon sticks in a ventilated drier at a temperature not exceeding 105° F., for one hour, protected from the air and sun. The cotton is then taken out, opened, put quickly back, and then kept in a dark drier for twelve hours at 95° F. The fiber takes on a dark green color.

2. For a lot of 1,800 pounds it is convenient to divide for the second operation into portions of 150 pounds each. Place for each portion 15 pounds of alizarine (10 per cent. paste) in a box containing 250 to 300 gallons of water. Enter and raise to a boil in 1½ hours, brighten with a solution of soda crystals at 1½° B., for two or three hours, or with a soap emulsion for three to four hours; allow to stand an hour and wash.

The resulting blue color does not crock, but is greened by acids, turned violet by alum and maroon by chlorine, but a simple wash with soda or soap always brings back the color. [This is expensive, but ought to prove effective in cases where no expense is to be spared to produce a blue which will not crock on cotton. L. M. N.]—*Textile Record.*

BEST METHODS OF MAKING INSTANTANEOUS PHOTOGRAPHS DURING BOTH DAY AND NIGHT, ILLUSTRATED BY EXPERIMENTS AND PROJECTIONS.*

By Dr. E. P. HOWLAND, of Washington, D. C.

INSTANTANEOUS photography by the discovery and introduction of dry plates has given a great impetus to science in every department. It is now necessary that investigators in most branches of science should have a practical knowledge of the art. It records his discoveries by a process of nature's engraving that is absolute truth. Any advancement in this art by discovery or application interests all investigators. In a condensed form, I will state some of the most important facts in relation to this subject and exhibit specimens of actual results.

The best lens for taking instantaneous photographs of landscapes and moving objects at a distance of 100 feet and over is a single achromatic lens, with the largest diaphragm that will give good definition, a single achromatic obstructing less light than a double achromatic lens with the same sized diaphragm and equal focus. As a single achromatic cannot be used for near objects, on account of distortion of the image, a double achromatic lens is absolutely necessary, with the largest diaphragm that gives good definition. Magnesium in powder with any substance that will cause a rapid combustion is the best substance known for producing a light for instantaneous photography in dark rooms or at night. Chlorate of potash, gun cotton, sulphide of antimony, picric acid, and other substances can be used with the magnesium, but I prefer magnesium with one-third its weight of flour of sulphur. This has given me perfect satisfaction, is a safe compound to use, and can be ignited by any burning substance or the electric spark. With the camera six feet from the object and the flash light two feet back and a little to one side of the camera, 30 grains of magnesium and 10 grains of sulphur, with a reflector behind the flask, will give a good photograph on an ordinary plate of No. 25 sensitometer or on an orthochromatic plate No. 27. At 12 feet distant, 120 grains of magnesium and 40 grains of sulphur is required. Good photographs can be taken on a 25 sensitometer plate at the distance of 24 feet by flashing 480 grains of magnesium and 100 grains of sulphur. On a 35 sensitometer plate, one half of this quantity is sufficient.

At a distance of six feet, this flash light I find is equal in its actinic effects on the plate to the ordinary ribbon magnesium lamp running thirty seconds, with a ribbon one-eighth of an inch in width and burning twelve inches of ribbon.

At 12 feet distance of camera, the flash light is equal to the exposure with magnesium lamp of two minutes and burning four feet of ribbon.

At greater distances than 12 feet, my experiments of comparison are indefinite. If a white screen is placed on one side of the object, opposite the side on which the flash is made, and a white screen or mirror behind the flash, it improves the illumination and makes the shadows less dense. The same result can be obtained by having on the other side of the camera 15 grains of magnesium and 5 grains of sulphur and igniting them both at the same time by a spark from a small Ruhmkorff coil. An intervening screen of translucent cloth or paper or ground glass between the flash and object will also give fine results, but more magnesium is required to be burned, as some of the light is obstructed. Exposures by day, when the time is less than one-tenth of a second, should be made from 11 A. M. to 2 P. M., in clear sunshine. The sensitive plate used for instantaneous work should not be less than 25 sensitometer, and fewer failures will be made with number 30 or 35. One of the photographs that I will show you is a street view and United States Custom House in Charleston, that I took after the earthquake at 12 M. on Sept. 16, 1886, on a 25 sensitometer plate with a single achromatic lens and of one-fifteenth diaphragm, clear sunshine, estimated time one-twentieth of a second, using a metal drop shutter. Another photograph is a street scene in Washington, corner Four-and-a-half street and Pennsylvania avenue, taken at 1 P. M., July 10, 1887, on a 35 sensitometer plate with a double achromatic lens, *f*, one-twelfth diaphragm, clear sunshine, time one two-hundredth of a second, using a Prosch shutter.

The moving objects in this photograph appear as if at rest in the attitudes seen. Another photograph is one that I took of a snow scene in Washington, corner of Seventh street and Pennsylvania avenue, at 11 A. M., April 1, 1887, on a 25 sensitometer plate with single achromatic lens and *f*, one-fifteenth diaphragm. Thin clouds and snowing slightly, estimated time one-fortieth of a second, using a drop shutter with rubber band accelerator.

The shorter time in which a photograph of moving objects is taken, when a good impression can be obtained on a plate, the more perfect the photograph. Prof. Muybridge has taken photographs of moving objects in the one five-thousandth part of a second.

Distance and velocity of moving objects must be taken into account in successful instantaneous photography. With a lens of five inch focus and object 1,000 feet distant moving at ten miles per hour, the image on the sensitive plate will change seventy-three one-hundredths of an inch in one second. A railroad train

* A paper read before the American Association for the Advancement of Science, Aug. 15, 1888.

moving at the rate of 40 miles per hour, at the distance of 400 feet, or a man walking two and one-half miles per hour, will change the image on the plate the same amount in the same time. The change of over one-half an inch in the image will make a mixed blur of objects, but if the time is reduced to the $\frac{1}{125}$ of a second, the image will then only change the .0030 of an inch, and this change of less than the four-thousandth of an inch will give a distinct image. The actual motion of a railroad train at 40 miles per hour is fifty-eight feet and eight inches per second. A street car at two miles per hour is fourteen feet and eight inches, and a man walking at the rate of two and one-half miles per hour is three feet and eight inches per second.

The method of calculating the change of image on the plate is the same as the lever, the long arm being the distance from the moving object to the lens, and the short arm the focus of the lens. The photograph of a lightning flash can be taken at night by adjusting the camera for distant objects by daylight and then at night pointing the camera with the cap off toward the thunder cloud and await the flash. A single achromatic lens is the best to use. A good photograph of a lightning flash that I will show you was taken by Prof. C. F. Marvin, of the United States Signal Office, June 19, 1887, at 3 A. M. Taken on a Carbutt plate No. 24 sensitometer, with double achromatic lens 10 inch focus $\frac{f}{10}$ diaphragm. The camera was left open four minutes, during which time several successive perpendicular and horizontal flashes were photographed on the plate.

The exposure was made in Washington, corner of Thirteenth and S streets, N. W. The building photographed on the plate by the lightning flash is Howard University. Good photographs can be taken of the sparks from an induction machine by having quart jars in connection with the prime conductors and using a short focus lens.

The exhibition of photographs of single sparks and of several in rapid succession were taken by myself with a five inch focus lens and $\frac{f}{6}$ diaphragm on a 35 sensitometer plate.

One photograph sent me from the United States Training School at Willets Point, New York Harbor, is that of a mule with his head blown off with a dynamite cartridge and photograph taken before falling to the earth. Taken with a 16 inch focus lens, $\frac{f}{32}$ diaphragm, on an Eastman plate, sensitometer 22, 2 P. M., sunshine and light clouds. Another photograph taken by Prof. T. W. Smillie, of the National Museum, Washington, is a mackerel schooner under full sail, taken from the deck of a steamer going in the opposite direction. Lens 16¼ inch focus, diaphragm $\frac{f}{16}$, exposure $\frac{1}{125}$ of a second, plate sensitometer 25, sunshine, 12 M. A photograph of base ball playing, showing balls in the air, was taken by Mr. C. C. Jones, assistant photographer United States surveys, with a detective camera of six inch focus, diaphragm $\frac{f}{24}$, at 4:30 P. M., July 15, time $\frac{1}{75}$ of a second, plate sensitometer 26.

The sensitive plates used in instantaneous photography, particularly the special orthochromatic, must be changed and developed in the least possible amount of actinic light, or the negative will not be clear and distinct.

The record I have given of the practical experience in instantaneous photography may be of service to many in their scientific investigations.

TYPES OF MARINE SIGNALS.

The high seas, even in heavy weather, present comparatively little danger to navigation; a really seaworthy vessel under skillful management usually lives through storms—even very severe ones—with ease, if it has only the storm to contend with, knowing that it is free from the dangers caused by proximity to the coast and by shoals, which often extend far out to sea.

It is a hard battle which often occurs out there in a dark night when a storm is raging; a vessel is a small object to contend against the great black masses of water, which thunder angrily against it, and whip foam and spray over it. However deep the ship sinks in the trough of the sea, and however alarmingly the waves roll on, as if to crush it with a single stroke, it rights itself again for each new sea. The planks and the joints tremble and creak, and the water runs from the deck in masses back into the sea. Often a man is washed away and vanishes with a cry, but the ship generally outlives the storm, and the hardships are forgotten when, a few days later, the warm sun shines over the glittering blue surface of the water.

The most severe storms are the typhoons which occur in the Chinese seas, with such astounding power that a vessel is completely crushed and annihilated. These calamities, however, form only a small part of the marine accidents, by far the greater number of which occur on coasts or shoals, and arrangements of various kinds have been adopted to lessen the dangers of such places. The chief enemies of vessels are, therefore, coasts, shoals, and reefs, darkness, and, the greatest of all, fog.

Shoals and channels near coasts and in rivers are marked by the erection of signals which can be seen at great distances. They consist generally of a strong framework of beams and laths, and are distinguished from each other by their peculiar shapes. The regulation of the whole matter of marine signals is in the hands of the government, which publishes charts on which all the different signals are carefully indicated.

If, for instance, a vessel goes up or down the Elbe, or any other river, the pilot or captain consults the proper chart, where he finds the beacons and buoys represented as shown in the accompanying illustrations. He compares these with the signals visible on the shore, and thus knows exactly where he is, and can follow the course indicated on the chart. Very often church steeples which are visible far out at sea are marked on charts and serve as beacons, giving the skipper his bearings. The shapes of lighthouses, which vary greatly, are shown on the charts, so that they serve to guide the seafarer by day as well as by night.

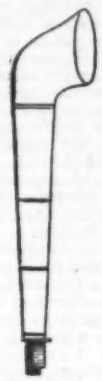
For denoting channels, etc., movable marks are used, and here the variously formed floating signals, buoys, come into play. The simplest form of buoy is a floating cask which is anchored, but great improvements have been made on this arrangement. Buoys have been made of strong sheet iron and provided with inscriptions or letters which can be seen at a great distance; others are filled at intervals—say once a month—with lighting material which supplies a steadily burning flame; still others are provided with bells—the "bell buoys;" and there are also the whistling buoys. These last are each provided on top with a deep sounding pipe, which is connected by air valves with the hollow space in the interior of the buoy. The motion of the waves causes them to give forth a deep tone which can be heard a long way. The light buoys have been very materially improved lately. Strong casings, which are built in the same way as steam boilers, are filled with gas under a pressure of eight atmospheres, and this quantity of gas will supply three or four flames for nine months; The gas flames do not act directly as light-giving bodies, but serve to heat a platinum wire, and thus a glow light is obtained which is visible much farther than the less intense gas light.

All of these modern devices are useful in the day time by their simple presence, and in the darkness by their audible and visible signals. Of course, all buoys are clearly indicated on the charts. Lighthouses vary so much in their shapes that it is scarcely possible to confuse the different ones, and at night they are distinguished by the many different ways of lighting. There are steady lights, intermittent lights, flash lights, a combination of two or more flames, etc. This variety is specially necessary where a dangerous coast or a difficult channel requires a number of lights.

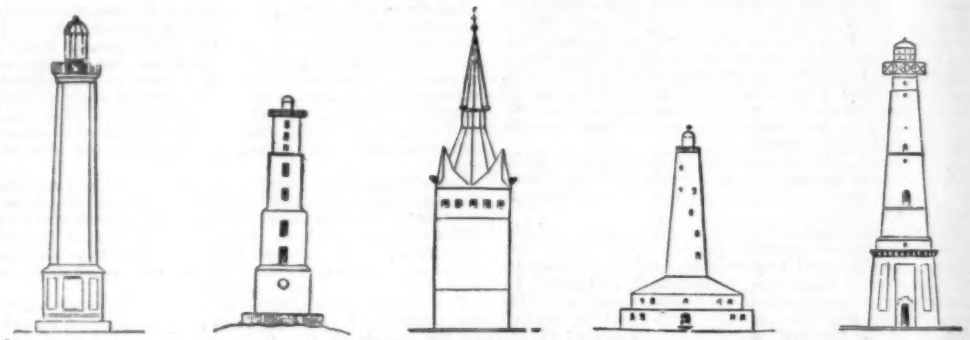
To telegraphy we owe a great number of marine signals. For example, in large ports and at the mouths of rivers, ships receive information as to the direction and intensity of the wind in neighboring ports—from which it has been telegraphed—by means of semaphores, which display signals in the shape of black balls and triangles.

In order to meet the worst enemy of the seafarer, fog, recourse must be had to signals which can be perceived by the ear. The oldest of these are cannon shots, fired at certain intervals; and then there are the steam whistles and fog horns, which are operated by compressed air or steam. The devices of this class which give forth the strongest sound waves are the sirens. The first one of these on the German coast was erected in 1875, at the entrance of the Kiel harbor.

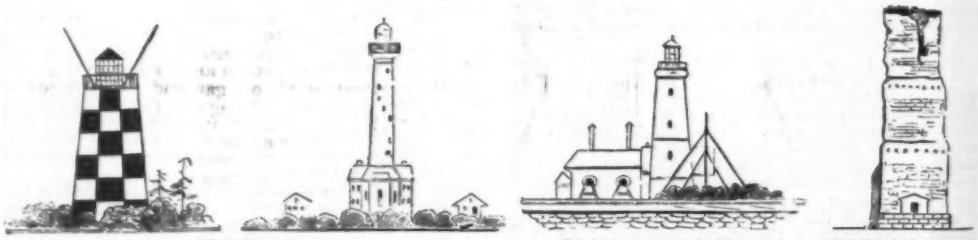
Plates of the Siren.



Foghorn.



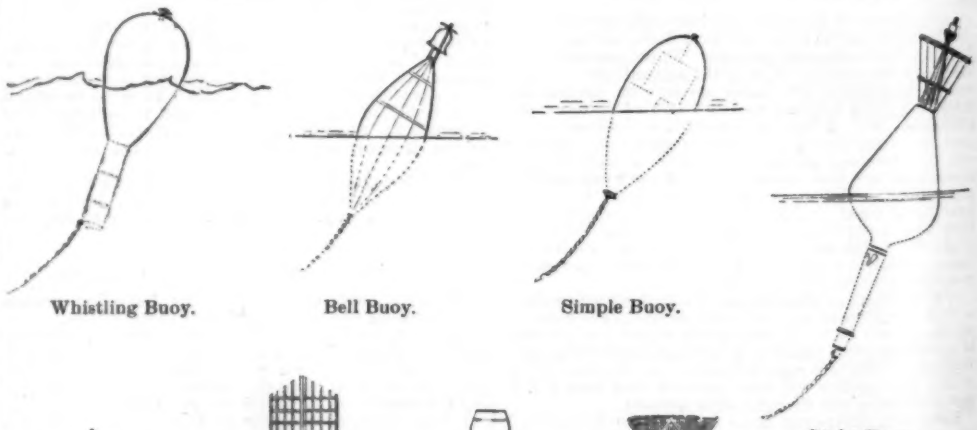
Lighthouses of Different Shapes.



Lighthouses.

Lighthouse with Siren.

Old Lighthouse at Heligoland.

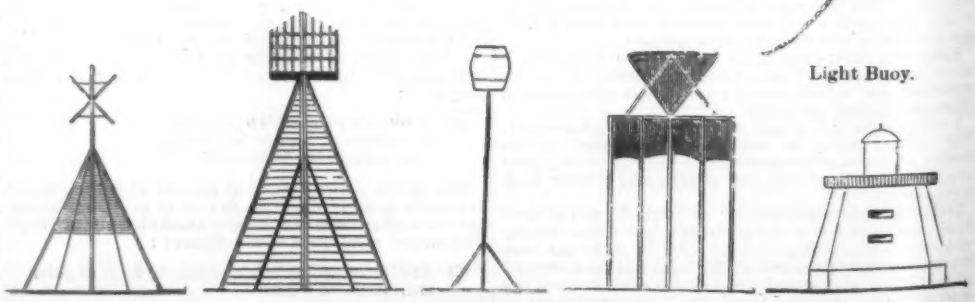


Whistling Buoy.

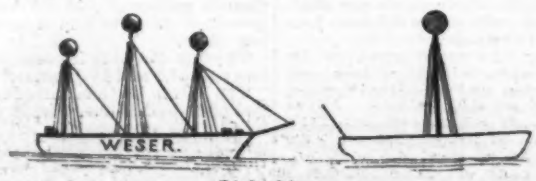
Bell Buoy.

Simple Buoy.

Light Buoy.



Beacons of Different Shapes.



Lightships.

TYPES OF MARINE SIGNALS.

The extraordinarily intense tone of this instrument, which can be heard at a distance of from 14 to 16 miles, is caused by the rotation of two plates placed one on the other and provided with equally distributed apertures, while an interrupted jet of steam is driven through by means of machinery. The German naval department has adopted sirens having different notes for signaling purposes.—*Illustrirte Zeitung.*

THE SCRUBBING, CONDENSING, AND WASHING OF COAL GAS.

By WILLIAM KEY, of Tradeston, Glasgow.

IN considering these subjects, I shall do so in the order given in the title to this paper, though not for any fanciful or accidental reason; for as I proceed it will become apparent to you why they are so placed. I shall also deal with the arrangement from a consideration of the mechanical effects produced on the gas, and will not enter into any question in the meantime of any improved results or otherwise in the secondary products either by tar or ammoniacal liquor, from the fact that there has been no opportunity of forming an opinion thereon.

Scrubbing.—The scrubbing and washing of coal gas have of late years become almost become synonymous terms; for in both vessels water is the chief agent employed, and motive power is also brought into requisition for both sets of apparatus, not only to rotate the apparatus, but also to supply means to distribute the water, and work up the resultant ammoniacal liquor, by repumping, etc., to the desired strength of the contained ammonia. I shall, however, make

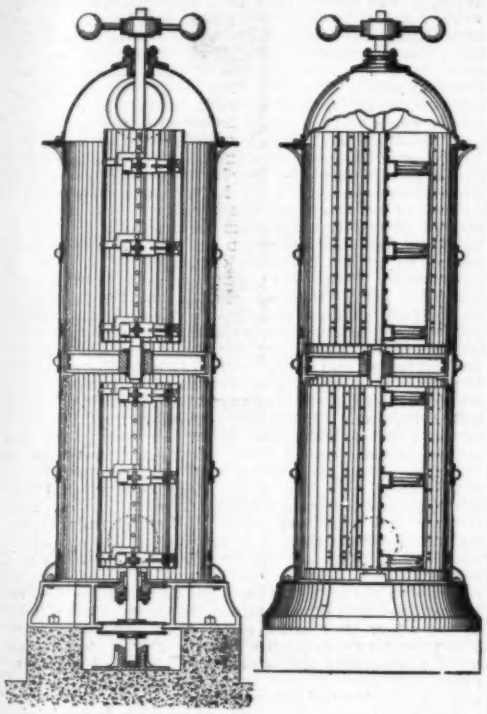


FIG. 1.

FIG. 2

a thorough distinction between these apparatus by designating the scrubber an apparatus for the extraction of the heavy condensable vapors; and no water will be used in connection with the arrangement I am about to describe for the purpose. Fig. 1 is designed for the extraction of the tarry and watery vapors from the gas while it is still hot. The gas flows direct to the scrubber on its leaving the hydraulic main. The passing of crude gas in pipes, along with the tar that may be condensed from it in its travel, for considerable distances, is most objectionable, and should be carefully avoided. The temperature of the gas must not be allowed to fall under 120° Fahr., and is preferably conducted to the scrubber as hot as possible.

This scrubber is designed of a capacity to thoroughly deal with 60,000 cubic feet of gas per hour; and is 5 ft. 3 in. inside diameter, by about 21 feet in height over all. The gas travels upward for 15 feet of this height, which is the distance between the inlet and the outlet pipes. Similar vessels may be placed in a horizontal position, and the one over the other, to effect the same purpose. The outer case of the scrubber is of wrought iron, and is lined the entire length with corrugated sheet iron. A shaft passes through stuffing boxes in the bottom and crown, to which is attached a grooved pulley, to be driven by a rope from another of a larger diameter fixed on a main shaft, and driven by an engine; so that by frictional or other gearing, one or more of the scrubbers may be set in motion as the increased manufacture of gas may demand. Keyed on to the scrubber shaft are several cast iron arms, to which are attached fans, butterfly wings, or "wipers," made of corrugated or ribbed sheet iron as shown; or several layers of wire cloth of various meshes may be used. These are caused to rotate at a speed of about 300 revolutions per minute; whereby the gas is repeatedly forced to pass through the narrowed and irregular passage between the corrugated iron lining of the outer case and the ribbed wipers. Thereby the gas is impinged upon by the revolving surfaces; and otherwise is made to impinge upon the corrugations of the scrubber case. Thus the whole of the tarry and watery vapors are extracted. In a vessel of this size, the flow of gas, at the rate of 60,000 cubic feet per hour, is sufficient to refill it three times in a minute; so that the wipers, revolving at 300 revolutions per minute, enable the gas in its passage through the vessel to receive 100 wipes or switches from the wipers before it passes off at the outlet completely scrubbed and clarified. I have here a model of this scrubber, made somewhat after the design shown by Fig. 4. The internal diameter between the corrugations of the case is 5 inches; and the height of the travel of the gas is 14 inches between the inlet and outlet.

I passed about 50 cubic feet per hour of crude gas through the scrubber, at a temperature of 120° Fahr., while it was stationary. These papers I now show you were exposed at a distance of say 0·1 inch from the outlet for 15 seconds by a stop watch; and they received the impression shown from the tar in the crude gas impinging on the surfaces. Thereafter the model was set in motion; and the other side of the papers was exposed for a similar time, with a result as shown. The whole of the tarry and watery vapors had been eliminated; and the surface of the paper impinged upon remained quite clean. Having attached a meter to the outlet, both while the scrubber was stationary and in motion, it was found that there was no retarding effect to the flow of the gas during the latter as compared with the former experiments. The same volume of gas was registered each time; thus indicating that the apparatus caused no back pressure—in fact, the water line of the pressure gauge remained steady under both conditions. The crude gas by this new process, having been thoroughly scrubbed and clarified, is now in a proper condition to be passed on to the coolers, generally termed the condensers.

Condensing.—Of all the apparatus used in the purification of coal gas, the designs for condensers are of the most heterogeneous description; and in some gas works, as more surface was required for this purpose, a different form has been brought into use each time, so that sometimes the gas is partly condensed by passing through the various sections in a combination with several of the following types of condensers: An enlarged hydraulic main; a pipe fixed round the inside of the retort house; a pipe carried round the outside of the retort house; an old boiler; a rectangular cast iron box; a disused gasholder; a gasholder tank; pipe condensers by far too small; pipe condensers by far too large; horizontal pipe condensers; vertical pipe condensers; spiral pipe condensers; portions of annular condensers; portions of battery condensers, etc. It is impossible to discover the particular recommendation that accompanied each section, and decided the position of each design along the line of cooling operations.

For many years past I have experienced much difficulty in speaking in the presence of gas manufacturers of the temperature to be maintained in the cooling process; in fact, I have been frequently assured that the temperature has not in any way to be considered in the purification of coal gas, and if the condensers possessed the quality of being able to lower the temperature of the gas to that of the atmosphere, then they were considered to be efficient in every respect. Bearing on this subject, I will read to you the letter which appeared in the "Correspondence" columns in the issue of the *Journal of Gas Lighting* dated October 4, 1881.

Of all condensers, I consider that the form most destructive to the gas in its application is the pipe condenser carried in long, straight lines, of a spiral form, with the pipes laid to a slight continuous fall, so that the gas might travel in contact with the tar. Then perhaps the vertical pipe condenser is the next most destructive; and along with this form, I would class the annular condenser—condensers so formed that when the temperature has fallen under 100° Fahr., the gas is passed slowly through a vessel of considerable area, and then through a small pipe, with consequently a very much increased velocity, to again enter a large vessel or chamber. This process, when repeated several times, must be very destructive to the illuminating power of the gas, and especially so as the temperature lowers, owing to the scrubbing process in these small pipes by the contact of the gas and the velocity of the impact with the cold and tarry surfaces—similar to what is frequently observable in towns where a rich gas is manufactured. The main pipe, which is too small to permit of the district being supplied under a low pressure, and a slow delivery, has to be put under a higher pressure. The gas passing through it at a great velocity, hydrocarbon vapors are deposited; and the rich gas, by frictional contact with such a surface at a low temperature, is deprived of its light-giving hydrocarbon vapors, and is found to be of a much lower illuminating power further on than when it was sent from the gasholders.

The gas as it passes from the hydraulic main does so in the familiar condition of being accompanied, while it is still hot, by a dense brown vapor, resembling smoke; the visible matter being hydrocarbon—tarry and aqueous vapors held in suspense. Any form of condenser to which the gas in this state is led, which necessitates it flowing through long straight lengths of pipe at considerable velocity, only serves as a means of carrying forward as far through the apparatus as possible these tarry vapors, because of the quick travel along unbroken lengths of pipe; and owing to the affinity tarry matter has at low temperature for the hydrocarbon vapors in the gas, the gas is lowered in illuminating value by several candles in passing through the last portion of such condensers where the temperature is low.

Some of the reasons why the annular form of condenser is one of the worst to employ as a cooler of coal gas are: (1) Because, the gas passing up or down the narrow annular space with a considerable velocity in a straight line, the tarry vapors are carried forward uninterruptedly. (2) The air space being surrounded by the annular chamber containing hot gas, the air in its passage upward becomes heated, so that the upper portions of the condenser tubes thereby lose much of their cooling power. (3) Owing to each individual annular tube being entirely separated from its neighbor, the changes of temperature brought about by hot rays of the sun, sudden showers of rain, by heat by day, and by cold by night. (4) Their singular form preventing thorough control over the temperature of the gas in severe, frosty weather.

I have not prepared a diagram to show you what, in my opinion, is the only true principle on which to construct what would be an effective condenser; but I may be privileged on another occasion to deal with the design of condensers. Meanwhile, it is enough if I say that apparatus for the cooling of coal gas, to be effective, must, in the hands of the manager of the works, be under perfect control; and not, like the annular condensers, allow the temperature of the gas to be so influenced by a sudden outburst of sunshine as to cause the thermometer to register an increase of 30° Fahr., or during a day of rain a lowered temperature by 20° or 30° Fahr. The apparatus should be so constructed that one-fourth, one-half, or three-fourths of it may be thrown out of action at will. Some to whom I have spoken have objected to this because of the first cost, and no amount of argument could persuade them that a careful study and watchfulness over the temperatures would enable them to save their first-class coals, and to work with a cheaper variety, and thereby the whole first cost of a proper condenser would be saved in one winter. Each section of condenser should have a series of thermometers and movable disks incased in glass, to show at a glance the temperatures and position of the controlling appliances, which, in the hands of the manager, would be adjustable week by week, day by day, or even from hour to hour if necessary; and by the application of a system of levers to control the whole without in any way altering valves or gas passages, unless when a change of surface, by putting in

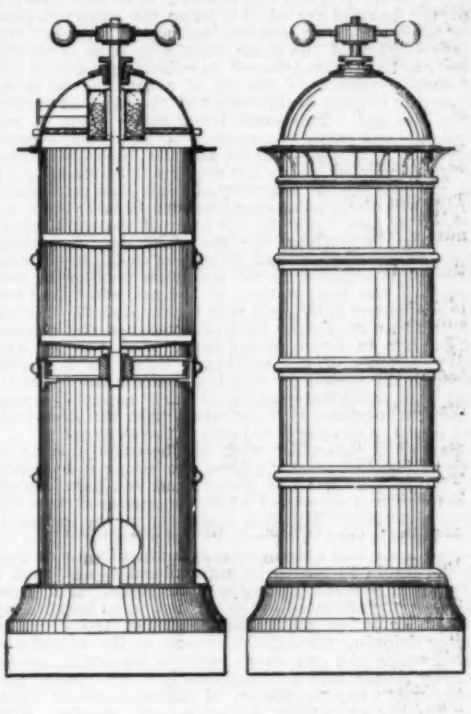


FIG. 3.

FIG. 4.

or out of action a section of the condenser, is required. An apparatus of this kind must not have the error of all vertical apparatus now in use—that of the air which comes in contact with the lower portions becoming heated and ascending, and getting more heated as it rises in contact with the pipes or surfaces—extracting less and less heat from the apparatus as it reaches the top; so that in our very variable climate, in all weathers, sunny, showery, frosty, or mild, and in all conditions of the manufacture, be it large or small, the condensing apparatus should be adjustable to all variations, and in the hands of the engineer be controllable to a steady outlet temperature of 60° Fahr.

In works where the gas is still maintained at an illuminating power of anything above 20 candles, the adoption of the scrubbing process just described, and so clarifying the gas before it enters the condensers, will enable the gas to be manufactured much more cheaply; and the greatest benefit will be obtained by those who fix upon a standard of higher illuminating power. In such works, by the employment of the old method of condensation, the most serious depreciation in the quality of the gas would be experienced. The hydrocarbon and other vapors that it is desirable should be taken from the gas as soon as possible after leaving the retort having been extracted by these scrubbers, the condensers will now properly perform their functions, in simply cooling the gas from 160° or 120° down to 60°; and they will remain one of the cleanest portions of the apparatus in a gas works. The exhausters will also be freed of gritty and tarry matter. By passing the gas too hot into the washers, the ammonia to be extracted is apt to remain in the gaseous state; and when the liquor gets heated above 70°, it loses much of the power of absorption from the loss of affinity which water has for the ammonia at lower temperatures. The temperature of the gas is re-

duced in the condensers to 60° in order to better prepare it for being passed on to the washers.

Washing.—The washer is an apparatus wherein water is employed to wash the gas. The water may be quiescent, and the gas caused to bubble up through it; or the water may be pumped up, or by other motive power made to drip through the gas as it passes through the vessel; or wetted surfaces may be rotated and exposed to the passage of the gas—all with the object of eliminating the ammonia and other impurities. Many managers have experienced, in both mild and severe winter weather a state of things whereby the washers act as condensers; and the liquor in the tanks rapidly becomes coated to a considerable depth with naphtha. The apparatus I am about to describe—in conjunction with the scrubber and condenser arrangements just mentioned—is designed so that the temperature of the gas would be prevented from being unduly cooled, and also the passage of any tarry naphtha to the washers would be an impossibility. The liquor would be made to do a maximum amount of duty; and the quality of the gas will not be impaired in passing through the water.

I have here an apparatus to illustrate the effect produced on illuminating gas by its coming into contact with oil, and before proceeding further will show it in action. The vessel is about 2½ inches in diameter and about 1 foot high, filled with small pebbles. I will now light two jets of equal size and brilliancy. The gas to supply one of them passes up through this small apparatus; and the gas to supply the other is branched off from the supply pipe to it. Having now poured in the U pipe by the filler a small portion of this crude heavy dead oil, obtained from the Clippens Oil Company's works, you will be enabled to at once observe how the flame of gas at the jet on the small scrubber has almost entirely lost its luminosity, although the shape and size of the flame remains as large as before. The gas having transferred its richest light-giving hydrocarbon vapors to the oil, of course the oil is increased in volume to the extent of the vapor extracted from the gas. This same thing takes place in the washers, and with the present form of condensers, especially in frosty weather; and the loss of the light-giving properties of the gas requires to be made up by an increase in the quantity of high class coals used, which will often, in a single month in midwinter, represent a sum equal to the value of the whole plant employed in washing the gas. The gas, in passing through the washers and scrubbers as at present constructed, is exposed to an enormous condensing surface, and the temperature of the gas, which had left the condensers at 60°, will now be found at 40° or even lower than 35° Fahr. In frosty weather, the contact of gas rich in hydrocarbon vapors with the oily and tarry surfaces of the scrubbing liquor as it passes through the vessels at this low temperature tends to, and does, cause the quantity of tarry naphtha in the vessels to increase, with the result that the illuminating power of the gas is reduced in the same ratio.

Every one is familiar with the beautiful display of prismatic colors resulting from the letting one drop of tar fall on the surface of water; and you have doubtless frequently wondered at the enormous surface one drop will cover. This film of oily tar on the surface of the water is very thin; yet the water under it has received a coating which prevents contact by air or gas. If the liquid so coated be ammoniacal liquor, such a film would prevent the escape of ammonia. If coal gas therefore be admitted to the washers in an imperfectly cooled or in an unclarified condition, the drops of water dripping through the vessel, or the wetted surfaces which the gas meets with in its course, are instantly coated with a film similarly to the water just mentioned; and the efficacy of the ammoniacal liquor for further extracting ammonia and sulphur compounds from the gas is impaired. Hence perhaps the most valuable result from the adoption of my suggested system of scrubbing and condensing will be found in the increased efficiency of the washers.

Every one knows that if a drop of water is broken up into numberless fine particles, such as mist or spray, thousands of times more surface is exposed on such a condition as compared with the surface of the drop. From this it is plain that, to get the greatest amount of work from water, instead of allowing it to pass through the gas in drops or small streams, each drop in falling only making an imaginary line through the gas (just as you would draw a vertical line on paper with a ruler), these should be dashed into spray, so that the largest possible surface be exposed to the gas.

I have designed a washer which will not only prevent the excessive cooling of the gas, but will by its powerful application in a comparatively small space permit of the rapid passage of the gas and the maintenance of the temperature at the outlet as near 60° as possible; and the gas will flow through the liquor that is lashed into foam or fine spray. The apparatus is shown in vertical section and cross section in Fig. 3. This washer itself is very similar in design to the scrubber, but has fixed to the crown, on its under side, an annular water tank and air vessel, to which are attached ten tubes, radiating from the tank and passed through the sides of the cover to afford access for cleaning the numerous small holes in them and in the bottom of the tank. Through these holes the water falls on to the revolving corrugated iron fans or wipers. By these the water is at once lashed into fine foam or spray, and with the gas is whirled round the corrugations of the lining of the case; and the gas will be struck by the wetted surfaces of the corrugations of the fans or wipers about 200 times ere it reaches the outlet—the centrifugal action causing the gas and spray to rapidly whirl through the wiper corrugated passages outward. I have arranged a series of beveled trays whereby the gas from a lower chamber in passing upward into the next higher one has to pass through a 20 inch opening in the center; and the water in falling from a higher chamber to a lower is directed by the beveled plates to the same opening. These plates have a large number of small holes, through which a portion of the water will drip on to the revolving wipers.

From the foregoing, the following claims have been brought before you as the object of my paper: (1) That the crude gas should be led, while as hot as possible, direct from the retorts to the scrubbers. (2) That a scrubber, somewhat after the design I have submitted to you, should be employed to scrub the gas perfectly clean from the tarry hydrocarbon and other vapors which it is desirable should be eliminated from the gas before it enters the condenser. (3) That the condensers should be employed solely as coolers, and not used as tar extractors. (4) The gas having first been clarified by the scrubbers, the condensers will remain clean if so used. (5) That the condensers, to be efficient in the hands of the engineer at the works, must be adjustable to alterations in the manufacture and variations of temperature; so that a steady outlet temperature of 60° Fahr. be maintained. (6) That, by these arrangements, the gas will be of higher illuminating power by its passage through the condensers in a clean state, in place of the tarry condition as at present; especially so will this be the case where the gas in the condensers has been allowed to fall to a temperature approaching that of the atmosphere in severe winter weather. (7) That by the scrubbing process and clean cooling of the gas, the washers will receive the gas in a condition to enable them to do a maximum duty. (8) The ammoniacal liquor will remain clean; and the liquor will be the more easily worked up to the desired strength. (9) The quality of the gas will not be destroyed as at present by contact with the oily and tarry surfaces of the liquor in the washers in winter.—*Journal Gas Lighting.*

ELECTRICAL ACTION DUE TO AN INTERVENING MEDIUM.*

By Prof. G. F. Fitzgerald, M.A., F.R.S.

The British Association in Bath, and especially we here in Section A, have to deplore a very great loss. We confidently anticipated profit and pleasure from the presence in this chair of one of the leading spirits of English science. Dr. Schuster. We deplore the loss and we deplore the cause of it. It is always sad when want of strength makes the independent dependent, and it is doubly sad when a life's work is thereby delayed, and to selfish humanity it is trebly sad when, as in this case, we ourselves are involved in the loss. And our loss is great. Dr. Schuster has been investigating some very important questions. He has been studying electric discharges in gases, and he has been investigating the probably allied question of the variations of terrestrial magnetism. We anticipated his matured pronouncements upon these subjects, and also the advantage of his very wide general information upon physical questions, and the benefit of his judicial mind while presiding here.

As to myself, his substitute, I cannot express how much gratified I feel at the distinguished honor done me in asking me to preside. It has been one of the ambitions of my life to be worthy of it, and I will do my best to deserve your confidence. Man can do no more; and upon such a subject "the less said, the soonest mended."

I suppose most former occupants of this chair have looked over the addresses of their predecessors to see what sort of thing was expected from them. I find that very few had the courage to deliver no address. Most have devoted themselves to broad, general questions, such as the relations of mathematics to physics, or more generally deductive to inductive science. On the other hand, several have dealt each with his own specialty. On looking back over these addresses, my attention was specially arrested by the first two past presidents of this section, whose bodily presence we cannot have here. They were presidents of Section A in consecutive years. In 1874 Provost Jellett occupied this chair, and in 1875 Prof. Balfour Stewart occupied it. Both have gone from us since the last meeting of this Association. Each gave a characteristic address. The provost, with the clearness and brilliancy that distinguished his great intellect, plunged through the deep and broad questions surrounding the mechanism of the universe, and with impassioned earnestness claimed on behalf of science the right to prosecute its investigations until it attains, if it ever does attain, to a mechanical explanation of all things. This intrepid honesty to carry to their utmost the principles of whose truth he was convinced, the utter abhorrence of the shadow of double dealing with truth, was eminently characteristic of one whom all, but especially we of Trinity College, Dublin, will long miss as a lofty example of the highest intellectual keenness and honesty, and mourn as the truest hearted friend, full of sympathy and Christian charity. In 1875 Prof. Stewart gave us a striking example of the other class of address in a splendid exposition of the subject he did so much to advance, viz., solar physics. He brought together from the two great storehouses of his information and speculation a brilliant store, and displayed them here for the advancement of science. Him, too, all science mourns. Though, from want of personal acquaintance, I am unequal to the task of bringing before you his many abilities and great character, you can each compose a fitting epitaph for this well known great one of British science. In this connection I am only expressing what we all feel when I say how well timed was the royal bounty recently extended to his widow. At the same time, the niggardly recognition of science by the public is a disgrace to the enlightenment of the nineteenth century. What chancellor or general with his tens of thousands has done that for his country and mankind that Faraday, Darwin, and Pasteur have done? The "public" now are but the children of those who murdered Socrates, tolerated the persecution of Galileo, and deserted Columbus.

In a presidential address on the borderlands of the known delivered from this chair, the great Clerk-Maxwell spoke of as an undecided question whether electromagnetic phenomena are due to a direct action at a distance or are due to the action of an intervening medium. The year 1888 will be ever memorable as the year in which this great question has been experimentally decided by Hertz, in Germany, and I hope by others in England. It has been decided in favor of the hypothesis that these actions take place by means of an intervening medium. Although there is nothing new about the question, and although most workers at it have long been practically satisfied that electro-magnetic actions are due to an intervening medium, I have thought it worth while to try and explain to others who may not have considered the problem what the problem is and how it has been solved. A presidential address such as this is not for specialists; it is for the whole section, and I would not have thought of dealing with this subject, only that its immediate consequences reach to all the bounds of physical science, and are of interest to all its students. We are all familiar with this, that when we do not know all about something, there are generally a variety of explanations of what we do know. Whether there is anything of which there are in reality a variety of explanations, is a deep question which some have connected with the freedom of the will, but which I am not concerned with here. A notable example of the possibility of a variety of explanations for us is recorded in connection with an incident said to have occurred in the neighboring town of Clifton, where a remarkable meteorological phenomenon, as it appeared to an observing scientist, was explained by others as a bull's eye lantern in the hands of Mr. Pickwick. Another kind of example is the old explanation of water rising in a pump, that "Nature abhors a vacuum," as compared with the modern one. Nowadays, when we know as little about anything, we say: "It is the property of electricity to attract." This is really little or no advance on the old form, and is merely a way of stating that we know a fact, but not its explanation. There are plenty of cases still where a variety of explanations is possible. For example, we know of no *experimentum crucis* to decide whether the people I see around me are conscious or are only automata. There are other questions which have existed, but which have been experimentally decided. The most celebrated of these are the questions between the caloric and kinetic theories of heat and between the emission and undulatory theories of light. The classical experiments by which the case has been decided in favor of the kinetic theory of heat and the undulatory theory of light are some of the most important experiments that have ever been performed. When it was shown that heat disappeared whenever work appeared, and *vice versa*, and so the caloric hypothesis was disproved; when it was shown that light was propagated more slowly in a dense medium than in a rare, the sciences of light and heat were revolutionized. Not but that most who studied the subject had given their adhesion to the true theory before it was finally decided in general estimation. In fact, Rumford and Davy's experiments on heat, and Young and Fresnel's experiments on light, had really decided these questions long before the erroneous views were finally abandoned. I hope that science will not be so slow in accepting the results of experiment in respect of electro-magnetism as it was in the case of light and heat, and that no Carnot will throw back science by giving plausible explanations on a wrong hypothesis. Rowland's experiment proving an electromagnetic action between electric charges depending on their absolute and not relative velocities, has already proved the existence of a medium relative to which the motion must take place; but the connection is rather metaphysical, and is too indirect to attract general attention. The importance of the striking experiments was that they put the language of the wrong hypothesis out of fashion. Elementary text books that halted between two opinions, and, after the manner of text books, leaned toward that enunciated in preceding text books, had all perforce to give prominence to the true theory, and the whole rising generation began their researches from a firm and true standpoint. I anticipate the same results to follow Hertz's experimental demonstration of a medium by which electromagnetic actions are produced. Text books which have gradually been invoking lines of force, in some respects to the aid of learners and in others to their bewilderment, will now fearlessly discourse of the stresses in the ether that cause electric and magnetic force. The younger generation will see clearly in electro-magnetic phenomena the working of the all-pervading ether, and this will give them a firm and true standpoint for further advances.

And now I want to spend a short time in explaining to you how the question has been decided. An illustrative example may make the question itself clearer, and so lead you to understand the answer better. In colloquial language we say that balloons, hot air, etc., rise because they are light. In old times this was stated more explicitly, and therefore much more clearly. It was that they possessed a quality called "levity." "Levity" was opposed to "heaviness." Heaviness made things tend downward, levity made things tend upward. It was a sort of action at a distance. At least it would have required such a hypothesis if it had survived until it was known that heaviness was due to the action of the earth. I expect levity would have been attributed to the direct action of heaven. It was comparatively recently in the history of mankind that the rising of hot air, flames, etc., was attributed to the air. Everybody knew that there was air, but it was not supposed that the upward motion of flames was due to it. We now know that this and the rising of balloons are due to the difference of pressure at different levels in the air. In a similar way we have long known that there is an ether, an all-pervading medium, occupying all known space. Its existence is a necessary consequence of the undulatory theory of light. People who think a little, but not much, sometimes ask me, "Why do you believe in the ether? What's the good of it?" I ask them, "What becomes of light for the eight minutes after it has left the sun and before it reaches the earth?" When they consider that they observe how necessary the ether is. If light took no time to come from the sun, there would be no need of the ether. That it is a vibratory phenomenon, that it is affected by matter it acts through—these could be explained by action at a distance very well. The phenomena of interference would, however, require such complicated and curious laws of action at a distance, as practically to put such a hypothesis out of court, or else be purely mathematical expressions for wave propagation. In fact, anything except propagation in time is explicable by action at a distance. It is the same in the case of electro-magnetic actions. There were two hypotheses as to the causes of electro-magnetic actions. One attributed electric attraction to a property of a thing called electricity, to attract at a distance; the other attributed it to a pull exerted by means of the ether, somewhat in the way that air pushes balloons up. We do not know what the structure of the ether is by means of which it can pull; but neither do we know what the structure of a piece of India rubber is by means of which it can pull; and we might as well ignore the India rubber, though we know a lot about the laws of its action, because we do not know its structure, as to ignore the ether because we do not know its structure. Anyway, what

* Address by the president, mathematical and physical section, British Association, Bath, 1888.

was wanted was an experiment to decide between the hypotheses of direct action at a distance and of action by means of a medium.

At the time that Clerk-Maxwell delivered his address, no experiment was known that could decide between the two hypotheses. Specific inductive capacity, the action of intervening matter, the delay in telegraphing, the time propagation of electro-magnetic actions by means of conducting material—these were known; but he knew that they could be explained by means of action at a distance, and had been so explained. Waves in a conductor do not necessarily postulate action through a medium such as the ether. When we are dealing with a conductor and a thing called electricity running over its surface, we are, of course, postulating a medium on or in the conductor, but not outside it, which is the special point at issue. Clerk-Maxwell believed that just as the same air that transmits sound is able by differences of pressure—*i. e.*, by means of its energy per unit volume—to move bodies immersed in it, so the same ether that transmits light causes electrified bodies to move by means of its energy per unit volume. He believed this, but there was no experiment known then to decide between this hypothesis and that of direct action at a distance. As I have endeavored to impress upon you, no *experimentum crucis* between the hypotheses is possible except an experiment proving propagation in time either directly, or indirectly by an experiment exhibiting phenomena like those of the interference of light. A theorist may speak of propagation of actions in time without talking of a medium. This is all very well in mathematical formulæ; but, as in the case of light, we must consider what becomes of it after it has left the sun and before it reaches the earth. So every hypothesis assuming action in time really postulates a medium, whether we talk about it or not. There are some difficulties surrounding the complete interpretation of some of Hertz's experiments. The conditions are complicated, but I confidently expect that they will lead to a decision on most of the outstanding questions on the theory of electro-magnetic action. However, there is no doubt that he has observed the interference of electro-magnetic waves quite analogous to those of light, and that he has proved that electro-magnetic actions are propagated in air with the velocity of light. By a beautiful device Hertz has produced rapidly alternating currents of such frequency that their wave length is only about two meters. I may pause for a minute to call your attention to what that means. These waves are propagated three hundred thousand kilometers in a second. If they vibrated three hundred thousand times a second, the waves would be each a kilometer long. This rate of vibration is much higher than the highest audible note, and yet the waves are much too long to be manageable. We want a vibration about a thousand times as fast again, with waves about a meter long. Hertz produced such vibrations, vibrating more than a hundred million times a second. That is, there are as many vibrations in one second as there are seconds—in a day? No; far more. In a week? No; more even than that. The pendulum of a clock ticking seconds would have to vibrate for four months before it would vibrate as often as one of Hertz's vibrators vibrates in one second. And how did he detect the vibrations and their interference? He could not see them; they are much too slow for that; they should go about a million times as fast again to be visible. He could not hear them; they are much too quick for that. If they went a million times more slowly, they would be well heard. He made use of the principle of resonance. You all understand how by a succession of well timed small impulses a large vibration may be set up. It explains many things, from speech to spectrum analysis. It is related that a former Marquis of Waterford used the principle to overturn lamp posts; his ambition soared above knocker wrenching. So that it is a principle known to others besides scientific men. Hertz constructed a circuit whose period of vibration for electric currents was the same as that of his generating vibrator, and he was able to see sparks, due to the induced vibration, leaping across a small air space in this resonant circuit. The well timed electrical impulses broke down the air resistance, just as those of my Lord of Waterford broke down the lamp post. The combination of a vibrating generating circuit with a resonant receiving circuit is one that I spoke of at the meeting of the British Association at Southport, as one by which this very question might be studied. At the time I did not see any feasible way of detecting the induced resonance; I did not anticipate that it could produce sparks. By its means, however, Hertz has been able to observe the interference between waves incident on a wall and the reflected waves. He placed his generating vibrator several wave lengths away from a wall, and placed the receiving resonant circuit between the generator and the wall, and in this air space he was able to observe that at some points there were hardly any induced sparks, but at other and greater distances from his generator they reappeared, to disappear again in regular succession at equal intervals between his generator and the wall. It is exactly the same phenomenon as what are known as Lloyd's bands in optics, which are due to the interference between a direct and a reflected wave. It follows hence that, just as Young's and Fresnel's researches on the interference of light prove the undulatory theory of optics, so Hertz's experiment proves the ethereal theory of electro-magnetism. It is a splendid result.

Henceforth I hope no learner will fail to be impressed with the theory—hypothesis no longer—that electro-magnetic actions are due to a medium pervading all known space, and that it is the same medium as the one by which light is propagated; that non-conductors can, and probably always do, as Professor Poynting has taught us, transmit electro-magnetic energy. By means of variable currents energy is propagated into space with the velocity of light. The rotation of the earth is being slowly stopped by the diurnal rotation of its magnetic poles. This seems a hopeful direction in which to look for an explanation of the secular precession of terrestrial magnetism. It is quite different from Edlund's curious hypothesis that free space is a perfect conductor. If this were true, there would be a pair of great antipoles outside the air, and terrestrial magnetism would not be much like what it is, and I think the earth would have stopped rotating long ago. With alternating currents we do propagate energy through non-conductors. It seems almost as if our future telegraph cables would be pipes. Just as the long sound waves in speaking tubes go round corners, so these electro-magnetic waves go round corners if they are not too sharp. Professor Lodge will probably have something to tell us on this point in connection with lightning conductors. The silvered glass bars used by surgeons to conduct light are exactly what I am describing. They are a glass, a non-conducting, and therefore transparent, bar surrounded by a conducting, and therefore opaque, silver sheath, and they transmit the rapidly alternating currents we call light. There would not be the same difficulty in utilizing the energy of these electro-magnetic waves as in utilizing radiant heat. Having all the vibrations of the same period, we might utilize Hertz's resonating circuits, and in any case the second law of thermodynamics would not trouble us when we could practically attain to the absolute zero of these, as compared with heat, long period vibrations. We seem to be approaching a theory as to the structure of the ether. There are difficulties from diffusion in the simple theory that it is a fluid full of motion, a sort of vortex sponge. There were similar difficulties in the wave theory of light owing to wave propagation round corners, and there is as great a difficulty in the jelly theory of the ether arising from the freedom of motion of matter through it.

It may be found that there is diffusion, or it may be found that there are polarized distributions of fluid kinetic energy which are not unstable when the surfaces are fixed; more than one such is known. Osborne Reynolds has pointed out another, though, in my opinion, less hopeful, direction in which to look for a theory of the ether. Hard particles are abominations. Perhaps the impenetrability of a vortex would suffice. Oliver Lodge speaks confidently of a sort of chemical union of two opposite kinds of elements forming the ether. The opposite sides of a vortex ring might perchance suit, or may be the ether, after all, is but an atmosphere of some infra-hydrogen element: these two latter hypotheses may both come to the same thing. Anyway, we are learning daily what sort of properties the ether must have It must be the means of propagation of light: it must be the means by which electric and magnetic forces exist: it should explain chemical actions and, if possible, gravity. On the vortex sponge theory of the ether there is no real difficulty by reason of complexity why it should not explain chemical actions. In fact, there is every reason to expect that very much more complex actions would take place at distances comparable with the size of the vortices than at the distances at which we study the simple phenomena of electro-magnetism. Indeed, if vortices can make a small piece of a strong elastic solid, we can make watches and build steam engines and any amount of complex machinery, so that complexity can be no essential difficulty. Similarly the instantaneous propagation of gravity, if it exists, is not an essential difficulty, for vortices each occupy all space, and they act on one another simultaneously everywhere. The theory that material atoms are simple vortex rings in a perfect liquid otherwise unmoving is insufficient, but with the innumerable possibilities of fluid motion it seems almost impossible but that an explanation of the properties of the universe will be found in this conception. Anything purporting to be an explanation founded on such ideas as "an inherent property of matter to attract," or building up big elastic solids out of little ones, is not of the nature of an ultimate explanation at all; it can only be a temporary stopping place. There are metaphysical grounds, too, for reducing matter to motion, and potential to kinetic energy.

These ideas are not new, but it is well to enunciate them from time to time, and a presidential address in Section A is a fitting time. Besides all this, it has become the fashion to indulge in quaint cosmical theories, and to dilate upon them before learned societies and in learned journals. I would suggest, as one who has been bogged in this quagmire, that a successor in this chair might well devote himself to a review of the cosmical theories propounded within the last few years. The opportunities for piquant criticism would be splendid.

Returning to the sure ground of experimental research, let us for a moment contemplate what is betokened by this theory, that in electro-magnetic engines we are using as our mechanism the ether, the medium that fills all known space. It was a great step in human progress when man learned to make material machines, when he used the elasticity of his bow and the rigidity of his arrow to provide food and defeat his enemies. It was a great advance when he learned to use the chemical action of fire; when he learned to use water to float his boats, and air to drive them; when he used artificial selection to provide himself with food and domestic animals. For two hundred years he has made heat his slave to drive his machinery. Fire, water, earth, and air have long been his slaves; but it is only within the last few years that man has won the battle lost by the giants of old, has snatched the thunderbolt from Jove himself, and enslaved the all-pervading ether.

TELEGRAPHING WITHOUT WIRES.

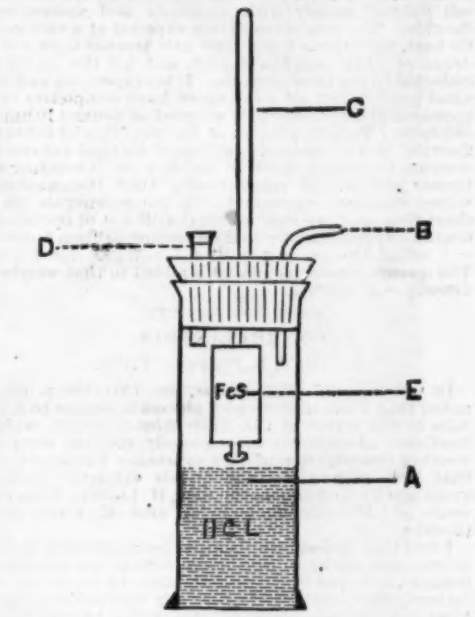
IT is well known that considerable difficulties are found in effecting telegraphic communication with lightships, and even with lighthouses on rocks at a distance from the shore. Mr. Willoughby Smith has, however, devised a method of effecting the object, which he has protected by patent, and which may probably be applicable to other purposes. He points out that at the present time, wherever electric telegraphic communication is established between the shore and a lighthouse, either floating or on a rock at a distance from the shore, it is effected through an insulated conductor or a telegraph cable; but much difficulty is experienced, owing to the rapid wearing of the cable, so that it is liable to break whenever a storm comes on, and when, consequently, it is most required to be in proper working order. By his invention he is able to effect communication between the sending station and distant point without metallic connection one with the other. This is effected in the case of a lighthouse erected on a rock at a distance from the shore by submerging one or more metallic plates or masses on opposite sides of the rock, so that the two plates or sets of plates may be as far apart as practicable, and from each plate or sets of plates he leads an insulated conductor to a telephone in the lighthouse. A two-conductor cable is led from a signal station on the shore toward the rock. At a distance from the rock one of the conductors of the cable is led to a metallic plate submerged on one side of rock at such a distance from it as to be in water deep enough for it not to be affected by waves. The other conductor of the cable is similarly led to another metallic plate or mass similarly submerged at a distance from the opposite side of the rock.

To communicate from the shore to the lighthouse, an interrupter or reverser and battery are connected to the shore ends of the two insulated conductors, and the telephone in the lighthouse responds to the repeated makes and breaks or reversal of the current, so that communication can readily be carried on by the Morse alphabet. If a vibrating interrupter or reverser be used, a short or long sounding of the telephone can be obtained by a contact key held down for short or long intervals. A more convenient way is to use two finger keys, one of which by a series of teeth on its stem, or in other more convenient way, produces a few breaks or reversals of the current, while the other key when depressed produces a greater number of breaks or reversals. In the same way communication could be carried on from the shore to a vessel at a distance from it, if the vessel were in the vicinity of two submerged plates or anchors, each having an insulated conductor passing from it to the shore, and if two metallic plates were let go from the vessel, so that these plates might be at a distance apart from one another. The position of the two submerged plates coupled to the submerged insulated conductors might be indicated by buoys. In this way communication might be effected between passing vessels and the shore or between the shore and a moored lighthouse or signal station. A similar result might be obtained with a single insulated conductor from the shore by the use of an induction apparatus with the ends of the secondary winding coupled by insulated conductors to submerged plates at a distance apart.—*Electrician.*

CHEAP APPARATUS FOR GENERATING SULPHURETED HYDROGEN.

By J. MARTIN, Lecturer at the Diocesan College, Rondebosch, Cape Town.

THE apparatus shown below for generating H_2S for a practical class was designed by me a short time ago, and has given the greatest satisfaction on the score of



both cheapness and convenience. The diagram will sufficiently explain its action.

A is a large glass cylinder, such as is used for deflagration experiments, tightly fitted with a well paraffined cork with three holes. C is a stout glass rod which passes through the center hole in the cork and through a hole in the bottom of a cylindrical porcelain vessel, E, which is supported by the end of the rod being flattened. The bottom of the porcelain vessel is drilled with several small holes. B is the delivery tube for the gas, and D is a short wide tube so placed that its lower end is perpendicularly over the interior vessel and closed at the top with a cork. The gas is, of course, generated by placing FeS in the porcelain vessel, and acid in the lower part of the glass cylinder, and pushing down the rod. The strength of the current can be regulated with considerable nicety. To charge the apparatus for use I take out the cork from the tube, O, and drop in small pieces of FeS, which fall into the porcelain vessel. The acid is sent in through the tube, B, by means of a funnel and India-rubber tubing. When the acid is the first to be used up, I draw up the interior vessel to the cork, take out the cork of the tube, D, and invert the whole apparatus. The liquid, of course, runs out, but the FeS is retained so as to fall back again afterward to bottom of the inside cylinder. I find that friction is sufficient to support the FeS, but to prevent accidents I place a small piece of caoutchouc tubing on the rod above.

The whole apparatus only costs about three shillings. It can, of course, be made of all sizes.—*Chem. News.*

EXAMINATION OF HONEY.

By K. KAYSER.

THE residue from the fermentation of pure honey is, as a rule, optically inactive, and, if heated with hydrochloric acid, it contains only exceptionally traces of reductive sugar. Sieben's first two methods for the examination of honey should therefore be modified as follows: 25 grms. honey are mixed with 12 grms. solid yeast (free from starch), and made up with water to 200

c. c., and let ferment for forty-eight hours at a medium temperature. Aluminum hydroxide is then added and the mixture made up to 250 c. c.; 200 c. c. of the clear filtrate are concentrated to 50 c. c. and polarized in a 200 mm. tube. A deflection of more than 1° (Wild) proves that starch sugar has been added. 25 c. c. of the liquid used for polarizing are then mixed with 25 c. c. water and 5 c. c. strong hydrochloric acid and heated for an hour in a boiling water bath, neutralized, made up to 100 c. c., and any sugar formed is determined by Allihn's method in one-quarter of the liquid. The sugar thus found, multiplied by 40, gives the quantity of sugar which comes to the fermentation residue from 100 grms. of honey. If this exceeds one per cent., starch sugar has been added.

A NEW METHOD OF DETERMINING LITHIUM BY MEANS OF FLUORIDES.

THE spectroscope gives valuable indications for the qualitative detection of lithia, but a comparison of the intensity of the spectral rays gives merely a doubtful approximation as to the proportion of the metal, especially if more than a few milligrammes per liter are present. The reagent used is ammonium fluoride. As the commercial salt is often contaminated with fluosilicate, it is purified as follows: Some grammes of the salt are dissolved in a small volume of water, a double volume of ammonia is added, the whole is boiled for a few seconds, let cool, filtered, and washed with ammonia. The silica is thus eliminated, and we have the fluoride in a strong ammoniacal solution, which is preserved in a covered platinum crucible. If we have in solution a few decigrammes at most of a salt of lithium with quantities of other alkaline salts not more than ten or fifteen times greater, we operate as follows: The solution is reduced to a few c. c. in a tared platinum capsule; ammonium fluoride and an excess of ammonia are added up to a volume of 15 to 20 c. c. The whole is well mixed and let settle, when there is formed a white gelatinous precipitate, scarcely visible, of lithium fluoride, which partly adheres to the bottom of the capsule. The next day it is complete, when we decant almost all the liquid upon a very small filter and pour in its place a few c. c. of ammoniacal water and ammonium fluoride, stir up with a platinum spatula and let settle. Soon afterward we make a second and a third decantation, and wash the filter with a few drops of the same reagent. Thus we remove all the soluble alkaline salts, and we have, partly on the filter and partly in the capsule, all the lithium salt imbued merely with ammonia and ammonium fluoride. The volatile matter is expelled at a very gentle heat, the filter is burnt, the ash treated with a few drops of dilute sulphuric acid, and all the liquid is collected in the tared capsule. It is evaporated and ignited gently until all acid vapors have completely disappeared and the residue is weighed as neutral lithium sulphate. To take account of the solubility of lithium fluoride in the ammoniacal liquid, its total volume is measured, ranging from 30 to 50 c. c. According to former results, and remembering that the washing waters remained in contact with the precipitate for a short time only, we may admit that 10 c. c. of the liquid contains approximately 2 milligrammes lithium fluoride = 4 milligrammes sulphate or 1 milligramme lithia. The quantity thus calculated is added to that weighed directly.—*A. Carnot.*

ON RHINANTHIN.

By Dr. T. L. PHIPSON, F.C.S.

IN my *Journal of Medicine*, etc. (No. 100, p. 66), I noted that I had discovered a glucoside similar to digitalin in the leaves of the *Antirrhinum majus*, which flourishes abundantly in the sandy soils of Surrey. Further investigation of this substance has shown me that it is *rhinanthin*, a glucoside extracted twenty years ago by an Austrian chemist, H. Ludwig, from the seeds of *Rhinanthus hirsutus* and *R. crista-galli* (Rattle).

I find that rhinanthin exists rather plentifully in the leaves and stalks of the *Antirrhinum majus* (snapdragon), and that it shows a reaction by which it can be recognized, even when present in very minute quantity in an aqueous solution. According to my experiments, rhinanthin can be extracted from the plant either by means of methylic alcohol or by cold water. The former process gives the larger yield, but the latter gives a purer product, and is in every respect easier and more economical. The plant, when fresh, is very brittle, and can be easily broken up or cut into small fragments, leaves and stalks, and allowed to remain in water in a closed vessel for a few days. The liquid is then filtered, treated with a small quantity of sub-acetate of lead (which does not precipitate rhinanthin), filtered again, and the slight excess of lead having been separated from the filtrate, the latter is evaporated carefully (on a water bath) almost to sirupy consistency, and then the vessel is allowed to remain in a warm, dry place for a few days. In these circumstances rhinanthin forms transparent colorless rhombic crystals, which are very brilliant; it can be purified by a second crystallization from water. It has a peculiar sweetish acrid taste, and is very soluble in water and in alcohol.

The aqueous solution of rhinanthin, to which a few drops of hydrochloric acid are added, and then heated, gradually turns brown, finally deposits an amorphous dark brown precipitate (*rhinothogen*), and the supernatant solution contains glucose.

This reaction is very sensitive, and precisely similar in appearance to the brown tint developed in solutions of glucose heated with soda (for instance, diabetic urine), only in the present case the color is produced by acid. A perfectly clear, colorless solution of rhinanthin in water, placed in a test tube with a few drops of HCl and heated, turns gradually brown, and in a few moments, just after the solution has reached its boiling point, it is quite dark and opaque. A copious precipitate of rhinanthogen results, in the form of a dark reddish brown amorphous powder, which can be filtered off and washed. The filtrate contains glucose.

This rhinanthogen dissolves in hot concentrated sulphuric acid, forming a greenish black solution. It is also attacked easily by nitric acid.

Ludwig has given to rhinanthin the formula $C_{18}H_{32}O_{16}$; my analyses of this substance do not exactly correspond with his single analysis, but lead to the formula—

$$C_{18}H_{30}O_{15}.$$

Nevertheless, I have not had sufficient of the product at my disposal to pursue this subject further at present.

In treating the decoction by subacetate of lead, it is well to employ as little as possible; the slight excess of lead can be removed either by carbonate of soda, phosphate of soda, or sulphureted hydrogen. I prefer the latter, though it leaves a small quantity of acetic acid free in the liquid to be evaporated; for I have found by direct experiment that dilute acetic acid will not convert the glucoside rhinanthin, as dilute HCl does, even after boiling for a considerable time; and on the water bath the presence of a minute quantity of free acetic acid is not, in this case, prejudicial. It is best not to evaporate to a thick sirup, but to stop as soon as indications of crystallization occur at the edge of the liquid. The capsule is then removed to a warm, dry place, where it remains for several days; the crystals thus formed are very white and brilliant.

The genera *Rhinanthus*, *Antirrhinum*, and *Digitalis* all belong to the same family of plants, and probably rhinanthin will be found to possess toxic properties; perhaps the toxic properties of *Linaria* (another closely allied genus) are due to it. But whatever may be its physiological properties, it is probable that rhinanthin, like digitalin, is very liable to allotropic changes and decomposition or oxidation. I believe that most of the substances extracted from *Digitalis* are really derived from allotropic or isomeric changes and from the decomposition of digitalin, and that these changes occur during the elaborate processes of extraction.—*Chem. News.*

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